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MAY 1948

Volume 35 No. 5

RESEARCH ISSUE

Plating

MONTHLY REVIEW OF THE AMERICAN ELECTROPLATERS' SOCIETY

IN THIS ISSUE:

What Is Research?
Electroplating Research
Strength of Nickel Deposits
Stress in Copper Deposits
Analysis of Cadmium in Nickel Baths
Stripping of Copper
A.E.S. CONVENTION and EXPOSITION
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A Steel Electrocleaner that can be used with either Cathodic (Direct) or Anodic (Reverse) current in every Cleaning Cycle prior to Bright Nickel or other plating operations.

FREDERICK GUMM Chemical Company Inc.

538 FOREST STREET, KEARNY, N. J.

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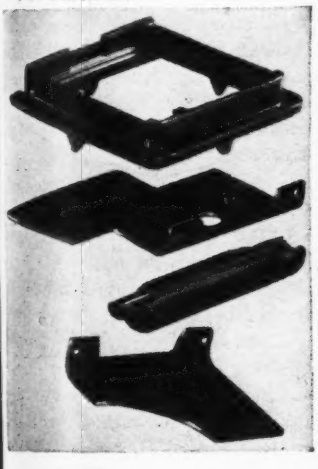
ANSCO

One of hundreds of users of the Enthone Alumon Process

New Ansco Automatic Reflex f 3:5 Camera.

Aluminum construction plated with nickel and chromium.



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ALUMON PROCESS OF PLATING OPENS IMPORTANT NEW USES FOR ALUMINUM

Hundreds of leading manufacturers now use plated aluminum — made possible and practical by the Enthone Alumon process. In addition to availability, you get aluminum's inherent advantages — lightness, low cost, durability, workability and strength — for articles requiring attractive plated finishes. Today you can plate aluminum with nickel, chromium, silver, gold and other metals, economically and just as simply as on steel or copper. New Enthone literature points out some of the new possibilities for the use of aluminum alloys in die castings, sand castings, rolled and wrought forms, all successfully plated by the Alumon Process.

Send sample parts for plating and technical advice from Enthone's experienced chemists.

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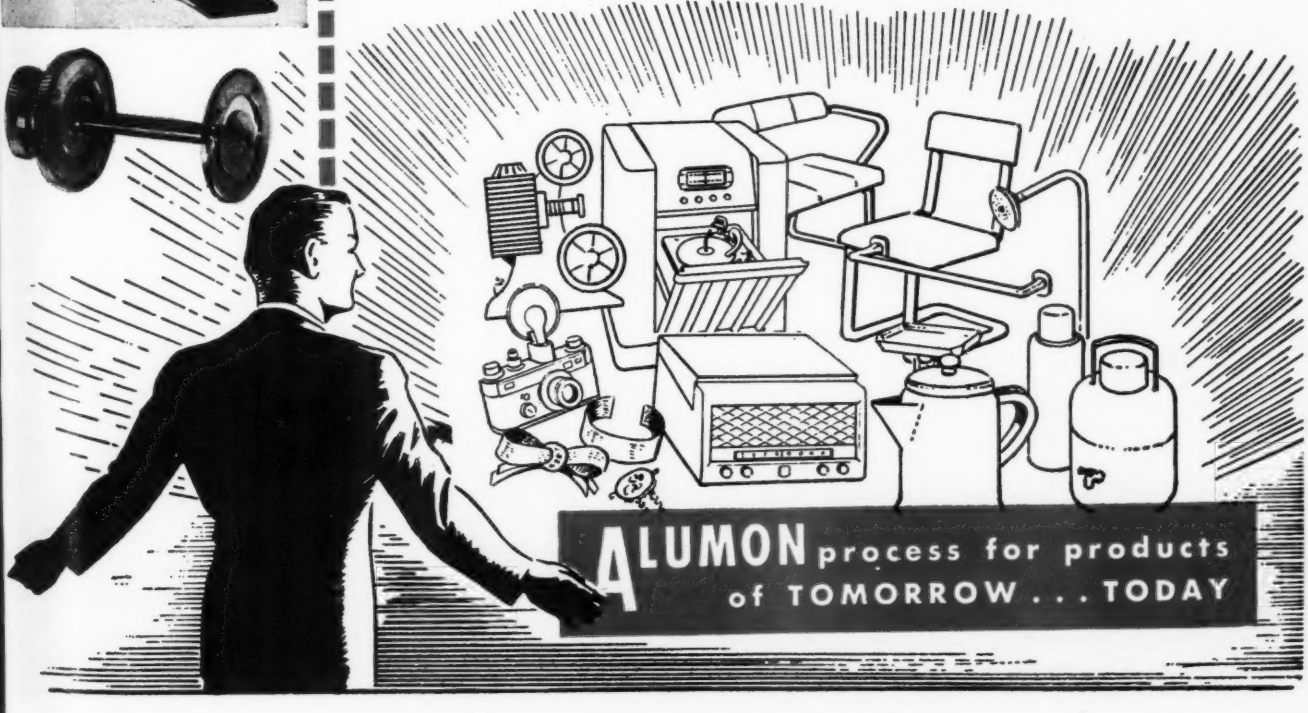

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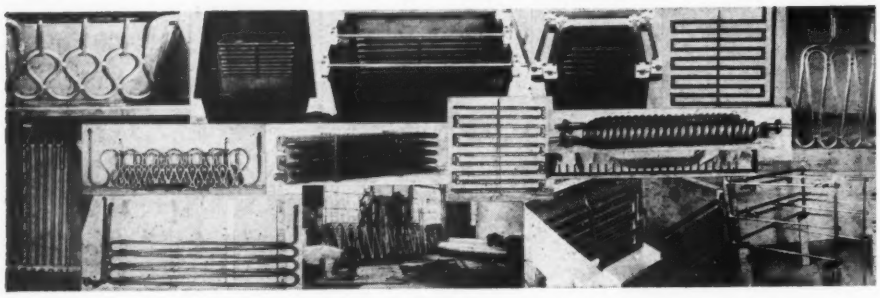

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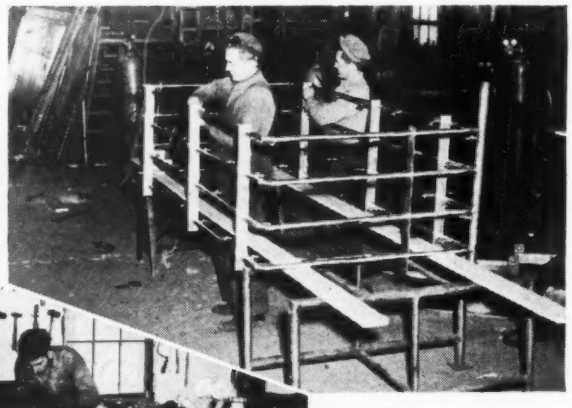
COILS BY **STORTS**



All sizes
All shapes
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FORMING and bending facilities for producing coils exactly to your specifications—many years of experience in making coils of all commercial metals and alloys—engineering design service to assure correct flow and efficient heat transfer—these are the reasons why you should transmit your current and future coil requirements to Storts.

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42 Stone Street Meriden, Conn.

Manufacturers of Welded Fabrications to Specifications

Industry News

A Three-point Program for Safety in Industry has been set up by the newly formed Industrial Safety Products Division of the Watson-Standard Company, Pittsburgh manufacturer of paints and finishes. This program includes complete cooperation with all safety organizations, extensive research directed at the creation of paints and finishes minimizing industrial hazards, and widespread educational promotion. Headquarters for the new division are located in the Clark Building, Pittsburgh 22, Pa.

Foster D. Snell, Inc., 29 W. 15th Street, New York 11, N. Y., Chemists and Engineers, have announced a further expansion of the services they render to clients abroad. The latest association is with Drs. Bredt and Van de Kasteele of N. V. Technisch Chemisch Adviesbureau of Eindhoven, Netherlands. Other overseas connections not previously published are association with MacTaggart and Evans, Ltd. of London, England, and O. A. Mendelsohn and Company of Melbourne, Australia.

Reynolds Metals Company, Louisville 1, Ky., has appointed two new distributors of its aluminum mill products: The Hamilton Steel Company, 12875 Taft Road, Cleveland, Ohio; and the Arthur C. Harvey Company, Harvey Steel Road, Allston District, Boston, Mass. These two new distributors will immediately become the established outlets in their respective areas for all Reynolds Aluminum Mill Products: sheet, plate, wire, rod, bar, rolled structural shapes, forging stock, extruded shapes, tubing, pipe, and similar products.

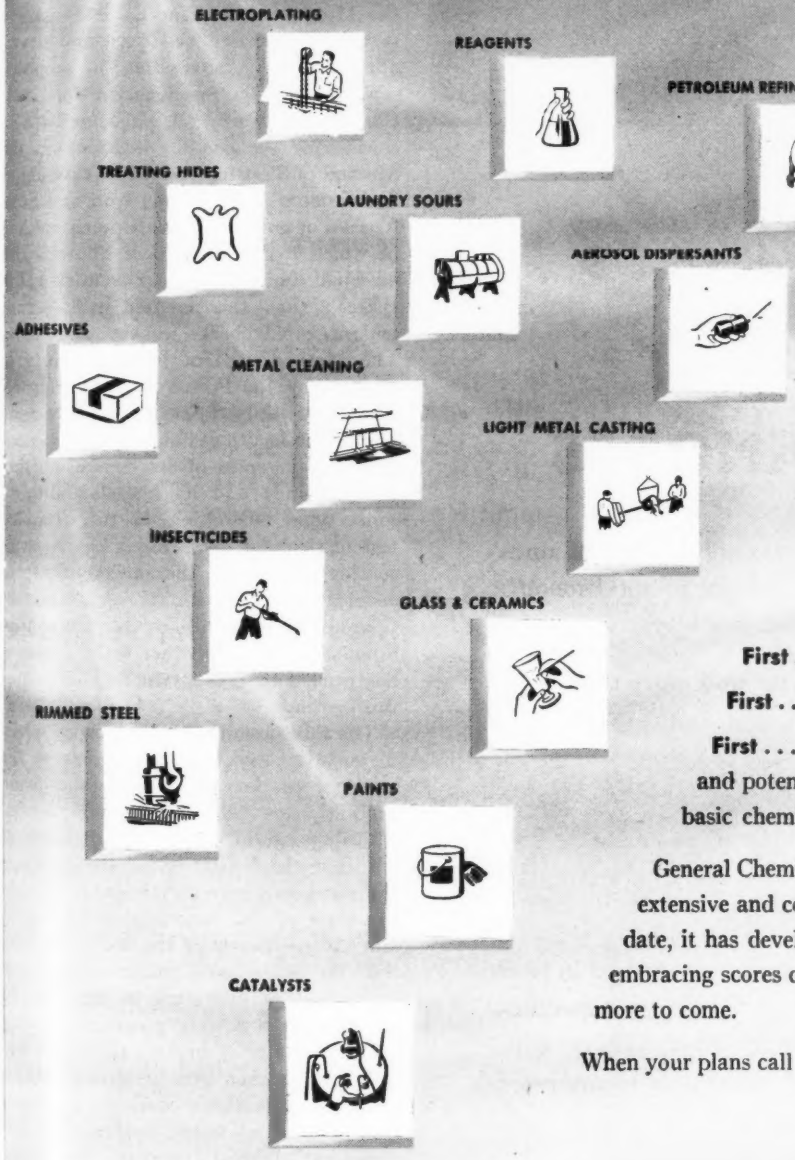
New York Job Shop Rate of Operations Rises. According to the Monthly Bulletin of the Masters' Electroplating Association, 123 William Street, New York City 7, the rate of operations among its members rose to 52 per cent in February from 50½ per cent in January. It was 64 per cent in February, 1947.

Island Equipment Corporation, conveyor manufacturers, with General Offices hitherto located at 101 Park Avenue, New York City 17, and factories at Hollis and Queens Village, L. I., has just

Published monthly at 5800 N. Mervine St., Philadelphia 41, Pa. Entered as second class matter July 1, 1946, at the Post Office at Philadelphia, Pa., under Act of August 24, 1916. Copyright, 1948, by the American Electroplaters' Society, Inc. Subscriptions: Domestic and Canada, $4.00 per year, 50c per copy; Foreign, $6.00 per year, 75c per copy.

General Chemical

FIRST IN FLUORIDES



Alkali Fluorides
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First . . . in the scope and achievement of its Research.

First . . . in the diversity and availability of its products.

First . . . in its work with Industry to develop the present and potential applications of these increasingly important basic chemicals.

General Chemical's Research in the field of fluorine chemistry is extensive and continuous, ever reaching into the unexplored. To date, it has developed nine major groups of fluorine compounds, embracing scores of organic and inorganic products . . . with many more to come.

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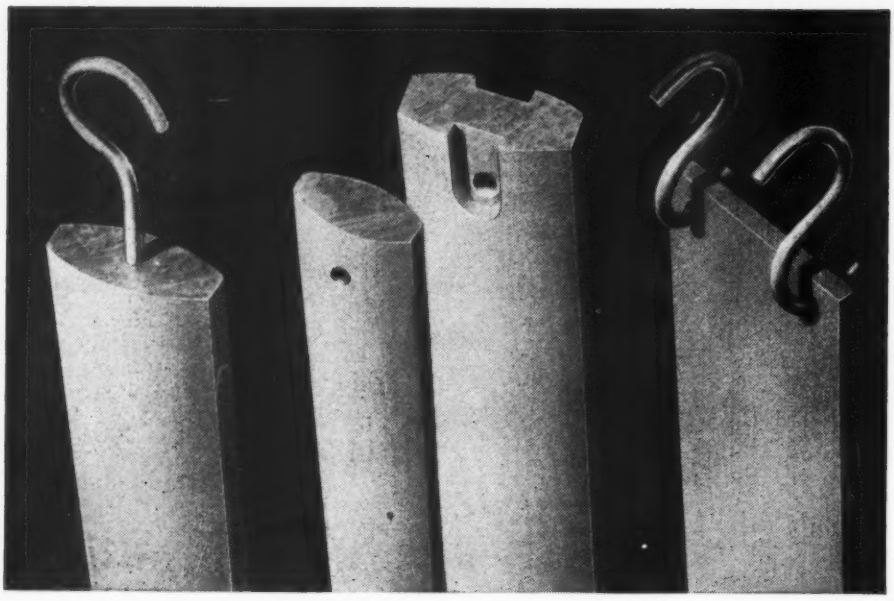

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1. **Copper goes into solution faster and more uniformly.**
2. **The highest quality deposit is produced in the shortest possible time.**
3. **Slime is reduced to an absolute minimum.**
4. **Spotting and discoloration of the deposit are minimized.**
5. **Scrap losses are exceptionally low.**

In addition to copper, Anaconda Anodes are furnished in brass and bronze... rolled Sheet or Oval... cut to your own specifications or standard sizes... drilled or undrilled... with or without hooks—also "cathode-anodes." For present or future reference, write for Publication C-5. 47272-A

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from mine to consumer

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Industry News

moved to new and much larger quarters in which the General Offices and Factories will be consolidated, all under one roof.

The new plant is that modern structure formerly occupied by Brewster-Rolls Royce organization at 27-01 Bridge Plaza North, Long Island City 1, N. Y.

A. S. T. M. Committee A-5 on Corrosion of Iron and Steel and most of its subcommittees participated in A. S. T. M. Committee Week in Washington. The committee is cooperating with Committee B-8 on Electrodeposited Coatings in making some check tests of the Method of Test for Local Thickness of Electrodeposited Coatings, and development work is proceeding on proposed revisions in the Specification for Lead-Coated Hardware. A subcommittee is considering the possible inclusion in the Method of Test for Weight of Coating of Zinc Coated (Galvanized) Iron and Steel Articles of an additional stripping method in which hydrochloric acid diluted with an equal amount of water is used. It is claimed that this method will permit making rapid checks on the shop floor. The Method of Test for Uniformity of Coating by the Preece Test is being reviewed to clarify the definition of the end point. The incorporation into many specifications, in spite of its somewhat limited accuracy and its inapplicability to some types of coating, of the dropping test method for determining thickness of coating has caused the subcommittee to decide to confer with representatives of Committee B-8 and of the Bureau of Standards to see whether some action is not needed to prevent further misuse of this method.

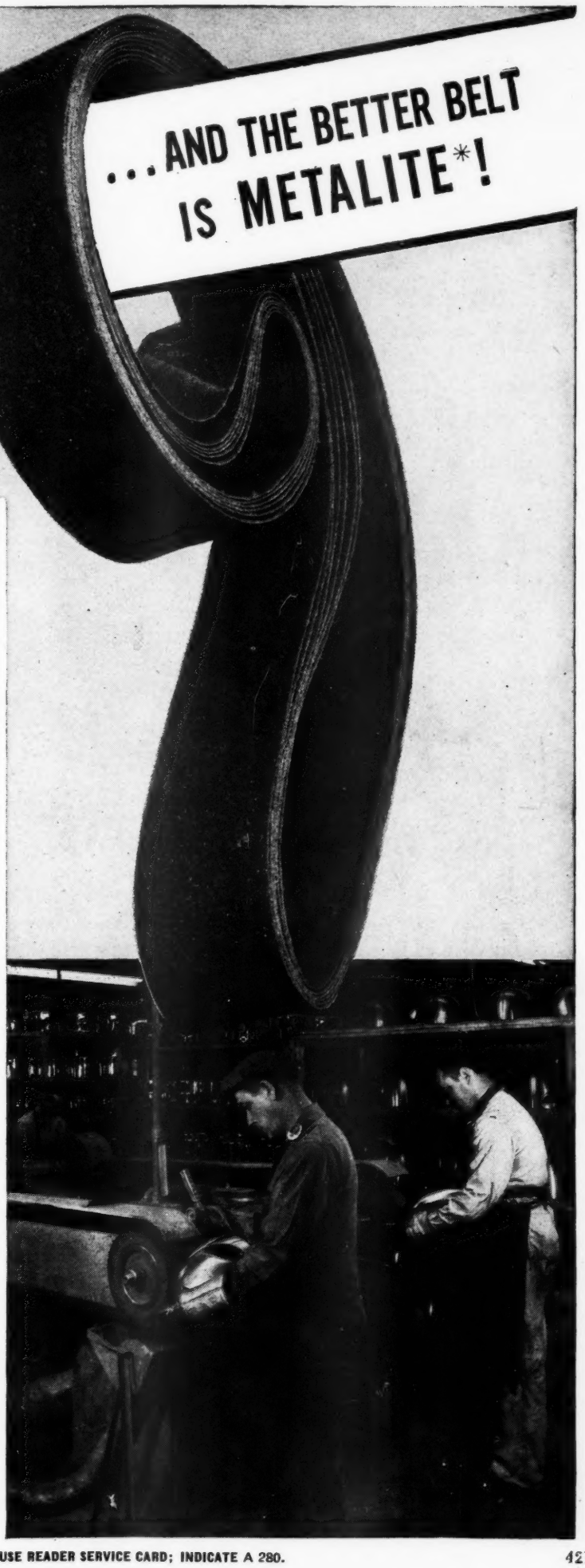
The Subcommittee on Hardware plans to make a more thorough review of the need for an extension to the hardware exposure test before proceeding further with its program. In the past it has been felt that the limitation of the exposure test specimens to materials coming within the scope of A-5 has reduced interest in and the usefulness of the test. A check will be made with other committees which may be interested in hardware, to see whether a testing program covering the exposure of specimens with base materials other than iron or steel and with other than metallic coatings for finish may not be advisable, rather than the somewhat limited program heretofore considered by A-5.

A. S. T. M. Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys at its meeting on Wednesday, March 3, during A. S. T. M. Committee Week in Washington, reviewed the work of some of its subcommittees.

The Subcommittee on Spray Test discussed some refinements in the Method of Salt Spray (Fog) Testing and recom-

THE BELT METHOD IS THE BETTER METHOD

...AND THE BETTER BELT IS METALITE*!



Back of the brilliant success story of the backstand-belt method, lies the equally brilliant production record of Behr-Manning Metalite* Cloth Backstand Belts for grinding, polishing and finishing. For the metal finishing industry has had to be shown the advantages of the belt method by competitive tests — tests which so consistently showed production increases of 2 to 4 times the old set-up wheel method.

Metalite Cloth Belts have sold the belt method because, as their name implies, they're right for metal. Their fast-cutting abrasive is genuine Norton Alundum grinding wheel grit, and each sharp, tough crystal is twice anchored with Behr-Manning's own Durabonded* adhesive that grips and holds under heat or pressure. The cloth backing is rugged and pre-finished for maximum adhesion and resistance to stretching. The Uniflow joint runs bump-free and true. That's why Metalite is right for metal. Write or wire or phone us for your own free demonstration of the belt method with <u>better</u> Metalite Cloth Belts.

*Reg. U. S. Pat. Off.

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Put the

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No matter what your burnishing problems may be, you'll find the answers in the *complete* Wyandotte line of burnishing compounds.

Wyandotte Burnishing Compound 317 gives a high luster to parts of zinc, nickel and Monel metal. It works effectively in either hot or cold water. And because this viscous liquid contains no soap or inorganic alkalies, its burnishing action is not affected by the hardness of water. It rinses freely and leaves no scum on the work or in the barrel.

Wyandotte Burnishing Compound 320 gives a highly satisfactory finish to brass, copper, bronze, carbon steel or stainless steel. It is a soap-type compound and contains a non-toxic brightening agent. It may be used for burnishing with steel balls or for combined burnishing and burring with chips or stones.

Your Wyandotte Representative will be glad to tell you more about these and other specialized Burnishing Compounds in the *complete* Wyandotte line. All you have to do is give him a call.

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Industry News

mended the sponsoring of a paper on apparatus and factors in such testing. The Subcommittee on Humidity Tests will enlarge its membership to include representatives of other A. S. T. M. main technical committees interested in humidity tests and will write up a method of humidity testing applicable to all types of materials. The Subcommittee on Weather has appointed a subgroup to study available instruments for the measurement of air pollution. This subcommittee also plans to expose specimens of zinc and iron at the several A. S. T. M. exposure test sites in order to obtain data on the corrosivity of each site.

Chromic Acid Still Very Short. The supply of chromic acid is still very inadequate. One of the important producers of this material, Martin Dennis Company of Newark, N. J., has retired completely from the production of chromic acid for electroplating. The other producers of this material, Mutual Chemical Company and du Pont, have not made up the deficiency and are not supplying the trade with its full needs.

The National Association of Metal Finishers, Inc., is working on this problem through its contacts with suppliers and the Small Business Division of U. S. Department of Commerce.

New Caustic Soda Facilities in the Saltville plant of Mathieson Chemical Corporation (formerly Mathieson Alkali Works) are now in full operation, according to the company's president, George W. Dolan. Half of the 100 per cent increase in the productive capacity at Lake Charles, La., came into operation in February and the balance is scheduled for completion this fall.

Unpublished Bibliographies. Numerous rare and unpublished bibliographies on scientific and technical subjects are now available to industry as the result of the formation of a pool of unpublished bibliographies by the Special Libraries Association. The bibliographies in each case have been compiled by technical librarians affiliated with the Association, many of whom are outstanding literature searchers in their respective fields.

The pool is housed in the library of Battelle Memorial Institute, Columbus, Ohio, from which loans of the bibliographies are made. Anyone interested in obtaining the complete listing of the bibliographies should write Ralph H. Hopp, technical librarian of the Battelle Library, who serves as chairman of the S. L. A. Bibliography Committee. His committee is also interested in the possible inclusion in the pool of other unpublished bibliographies.

The Shopmen had us in Stitches!

One guy snickered when they set us up on the lathe, but buff oh buff, how we Duluth Sewed Buffs laughed off that finishing job. Yes suh, Senator, that job was smooth! After my pals polished up those parts the foreman asked the purchasing agent to rush a big order to Duluth Buff Company in Chicago.

My pals come in all types of sewings: Square Sewed, Spiral Sewed, Radial Sewed, Radial Arc Sewed, Spiral-Radial Arc Sewed and Parallel Sewed. They each put on a special performance; the closer the sewing the faster the cut—the wider the sewing the better for coloring.

You can't laugh off those stitches when you see how they keep us from wearing out too fast . . . and brothuh, how we hang on to those abrasives. Y' know, we'd like to hear from you, so why don't you write Duluth Buff Company, Chicago 16, Illinois, so we can come out and visit you . . . you'll like our act . . . we'll have you in stitches so that you can sew up some more of those profits, too.

DULUTH BUFF COMPANY

CHICAGO 16, ILLINOIS

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Industry News

Plating Shop Overhead was the subject of discussion at the March meeting of the Chicago Electro-Platers' Institute, an organization devoted to the interests of the job plating industry in the Chicago area. A committee was appointed to explore the possibility of compiling representative industry data on ratios of material costs and labor costs to total sales. The variety of operations employed and the varying size of the firms makes the task a difficult one.

Instrumentation Course. The Bristol Company, Waterbury. Conn., manufacturers of industrial instruments, is conducting a series of courses for plant instrument and operating men in the Theory and Application of Industrial Instruments. Each course consists of two weeks of intensive lectures and laboratory work, with special emphasis on instrument maintenance and repair. Subjects covered include instruments for pressure, temperature, relative humidity, flow, *p*H and electrical measurements; pyrometry; pneumatic, electric and electronic control systems, and telemetering.

These courses are open to men interested in the application, servicing, and repair of instruments in all types of manufacturing plants. and are under the direction of Mr. F. A. Faust, Education Department, The Bristol Company, Waterbury 91, Connecticut.

A. S. T. M. Advisory Committee on Corrosion. For over forty years a number of Committees of the American Society for Testing Materials have conducted atmospheric exposure tests at sites throughout this country and in the tropics, now numbering some twenty-six, to determine the effect of various atmospheres on metals, metal coatings, paints, etc. Within the past two years, authority for the acquisition and maintenance of such sites has been vested in the A. S. T. M. Advisory Committee on Corrosion. A program to establish some half dozen sites where security and length of tenure can be assured was one of the main topics discussed by the Committee at its meeting on March 2 in Washington during A. S. T. M. Committee Week.

This committee, of which Dr. C. D. Hocker of Union College, Schenectady, is chairman, has selected the smaller number of sites as being representative of conditions useful for test purposes for most of the committees of the Society interested in atmospheric corrosion testing. The Advisory Committee also discussed the need for fundamental basic research on the mechanism of stress-rcorosion.

"Melting and Refining of Modern Steels" is the title of a movie shot at the Brackenridge, Pa., plant of Allegheny Ludlum Steel Corporation. It is a start-to-finish story of stainless steel as it is melted in an ultra-modern 50-ton electric furnace.

During twenty minutes of sensational color and action, every high point in the melting process is covered. Telephoto lenses were used for interior shots which make it appear that the camera is actually inside the furnace with molten metal boiling at temperatures hotter than an active volcano.

Designed for technical groups, this instructive and entertaining film may be obtained for free showings on request to the company's headquarters, Pittsburgh 22, Pa.

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for all Metals or Combination of Metals

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BLACOSOLV

FOR SOLVENT VAPOR DEGREASERS

No need to use a special solvent for cleaning a combination of metals—BLACOSOLV degreases them all . . . Safely . . . Quickly . . . Economically.

BLACOSOLV is the most highly stabilized solvent . . . ideal for aluminum, magnesium, brass, copper, steel, etc., either individually or in combination. It is non-inflammable—is positively safe—will not stain or dull even the most highly polished surfaces . . . the one price solvent for all metal degreasing jobs. Its economy is increased in the uninterrupted service it affords you in your production.

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● Here's an M&W finish that permits accurate retention of all desirable surface qualities of most metals . . . that adds lasting protection against heat, cold, weather, corrosion, stain and perspiration — Dulac Clear Universal Lacquer #462. It's formulated to give good adhesion with either the spray, dip or brush method. And it fits into fast production schedules because in five to ten minutes this successful general purpose lacquer dries out of dust . . . hardens in one hour. For complete information, write for Technical Data Bulletin 110 or let an M&W technical consultant discuss your requirements privately with you.

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2 Minutes
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by immersion

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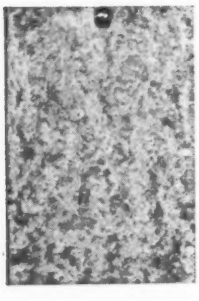
ALODIZED aluminum panel. After 800 hours' exposure to corrosive salt mist, the metal is still intact and well protected even without paint.



Alkali-cleaned aluminum. After only 300 hours' salt spray exposure, the metal is badly corroded over its entire surface area.

Alodizing with "ALODINE" is a simple, rapid chemical process. It protects the metal and anchors the finish -- gives aluminum a new degree of durability. For the utmost in paint-bonding and corrosion-resistance, ALODIZE aluminum surfaces.

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Durability Certified
ALODINE ANCHORS THE FINISH

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Personals

Dr. K. J. Keating has been appointed Manager of the Smith-Davis Company of 10751 Venice Boulevard, Los Angeles 34, Calif., a division of Maas and Waldstein Company, Newark, N. J. Dr. Keating received his education at North Dakota Agricultural College, where, upon completion, he was retained for two years to serve as instructor in paint, varnish, lacquer, and industrial chemistry. Prior to his appointment with the Smith-Davis Company, Dr. Keating was associated with several national organizations in executive capacities.

Jones

F. E. Jones has been appointed sales representative for the Eastern Central States by Michigan Chrome and Chemical Company, 6340 E. Jefferson Avenue, Detroit 7, Mich. He will represent the complete line of Miccro products—rack coatings, stop-off lacquers and corrosive resistants for the plating industry, covering the states of Ohio, Kentucky, West Virginia, western Pennsylvania, western New York State and Canada.

His previous connection was with the Veterans Administration as a training specialist supervising the training, in metal trades, of veterans studying and working under the G. I. Bill in the Detroit area. He saw infantry service with the Marines in the Pacific theatre, receiving the Purple Heart for wounds suffered at Bougainville.

He has been associated with the sales department of Greenfield Tap and Die Corporation in the Chicago area, and was district manager of sales for the General Implement Company of America, covering the Mid-Western States. Mr. Jones attended Wayne University, majoring in Business Administration.

J. E. Sawtelle has been appointed manager of the Export Division of the Hinderliter Tool Company Division of the H. K. Porter Company, Inc., and will be located at the offices of the H. K. Porter Company, Inc., 50 Church Street, New York 7, N. Y.

Mr. Sawtelle, a graduate of Rice Institute, worked for Creole Petroleum Company (Standard Oil Company of Venezuela) in Venezuela for several years.

Burnishes Better and FASTER

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Patented bearing construction assures smooth running — No vibration even with capacity load.

Direct Drive — No belts. Gears fully enclosed.

Motor mounted on top, out of the way — Stays dry — Easily accessible.

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Self-sealing cover of light-weight aluminum.

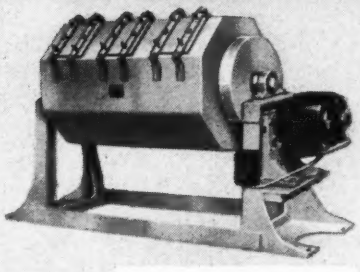
Spring-pressure ratchet lock, released by handy foot lever, holds barrel securely at any angle.

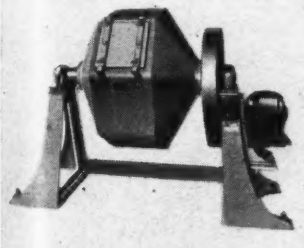
Hard maple lining — easily removable.

Three standard sizes.

DEBURRING BARRELS

3 - compartment barrel can be used for three different deburring jobs at one time. This model is also available with 1, 2 or 4 compartments.

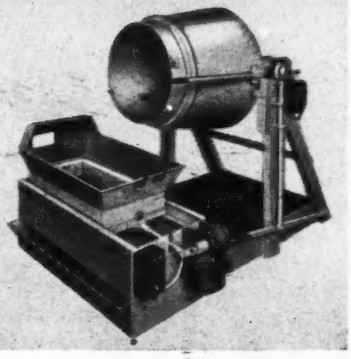




Triple-Action Deburring Barrel for very fast cutting. Specially shaped sides greatly increase tumbling action and reduce deburring time. Ideal for removing heavy burrs and smoothing extremely rough surfaces.

SAWDUST DRYING BARREL

Combination Steam-Heated Sawdust Barrel and Separator. The winning combination for maximum efficiency. Dries the work quickly, leaving it bright and spotless, and separates it from the sawdust without handling.



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The Modern Low-Cost Method of burnishing stampings, die castings, machined parts and other small pieces. Produces more uniform work with less rejects, and requires less space and labor.

Heavy, welded-steel frame and base affords absolute rigidity. Will not warp or twist when used on rough or uneven floors. There are no protruding feet or braces to interfere with the operator. Patented radial and thrust bearing construction assures that the balls always run in a perfect race regardless of the position of the barrel, providing smooth, long wearing operation.

Write for additional information today or ask to have a BELKE Engineer call and help you select the proper barrel and tumbling compound to do your job most efficiently.

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Spray and Dip Compounds for Cutting and Mirror Finishing. Double-Header Compounds in sizes 150-180-220-240-320

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SPARKLER
Horizontal Plate
FILTERS

Because the filter cake is held horizontally, it is absolutely stable to the end of each filtering cycle. And cycles are longer because the cake retains its porosity longer. That is why the "horizontal principle," as embodied in Sparkler filters, gives you more efficient, low cost, operation. Sparkler filters are pressure-tight and leak-proof, designed for intermittent or continuous operation.

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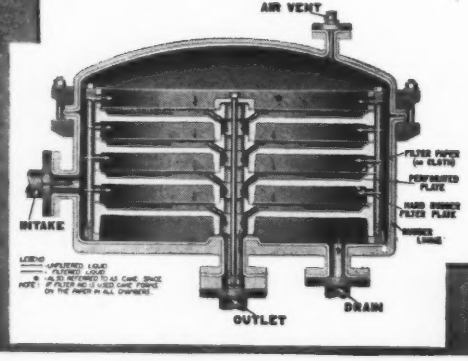

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Personals

Returning to the United States, he worked for the Baker Oil Tools, Inc., as a Sales Engineer, until the outbreak of World War II. Mr. Sawtelle entered the United States Army as a private in 1941 and was released in February, 1946 as a Major, having seved as Aide-de Camp to Lt. General A. M. Patch, Commander of the Seventh Army.

Win

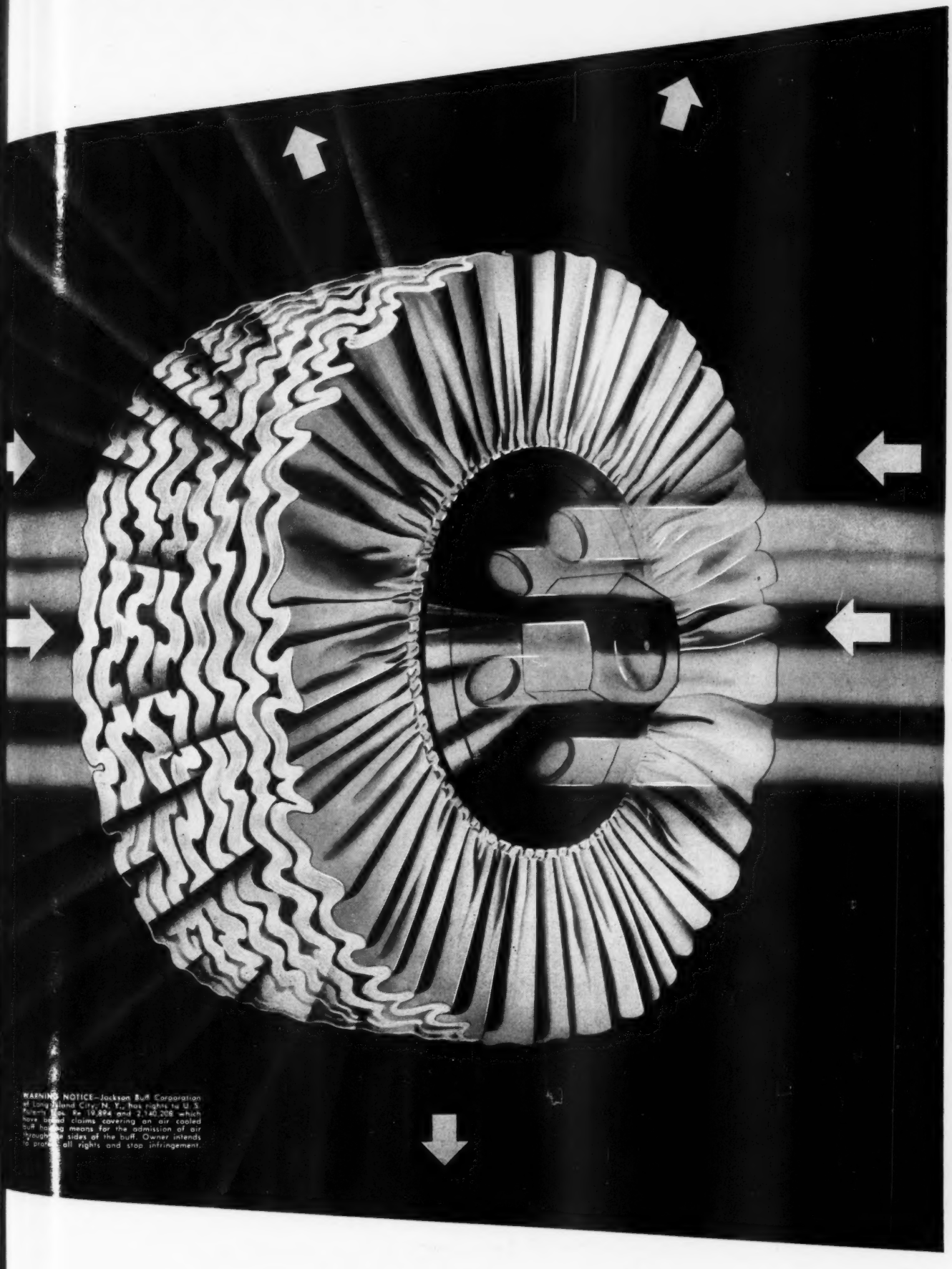
Murray M. Win has recently been appointed to the sales force of the Smith-Davis Company of 10751 Venice Boulevard, Los Angeles 34, Calif., a division of Maas and Waldstein Company, where he will cover a large section of the Los Angeles territory. Mr. Win has had many years of experience in the field of specialized production finishes, having served as sales engineer for some of the larger Eastern paint, varnish, and lacquer manufacturers. Mr. Win's experience and knowledge should be invaluable in making Pacific Coast manufacturers' finishing problems simpler.

William Di Leo has been appointed to the plastics section of the research, testing, and service laboratory of Lupomatic Industries, Inc. He is to exploit the many Lupomatic processes for tumbling plastic parts to a high lustrous finish.

Mr. Di Leo has had many years of experience with plastic manufacturers and fabricators in creating more effective combinations of compounds and carriers to insure quality control of finishing operations through tumbling.

Henry Nelkin, founder and president of Henry Nelkin, Inc., 128 Mott Street, New York, passed away on Tuesday, March 2, after a long illness.

Mr. Nelkin was one of the oldest and best known job shop operators in the New York Metropolitan District. His firm was a pioneer in the electroplating of lamps and lighting fixtures and is an outstanding factor in the finishing of these products. It was founded about thirty-five years ago and is today one of the largest job or contract electroplating firms in New York. The firm will continue under the management of Julian Nelkin, with no change in its long established policies.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Personals

Andrew Sorgenti of the Wenzel Plating Company, 88 Walker Street, New York City, suffered a heart attack recently and has been confined to his home. We are glad to report, however, that he is recovering steadily and that his condition is very satisfactory.

Reese

Dan S. Reese has been named to the post of Personnel Manager for the Stamford, Conn., plant, Zapon and Zapon-Keratol Divisions, of the Atlas Powder Company, according to Mr. E. H. Bucy, General Manager of both divisions.

Mr. Reese, a graduate of the University of Illinois, who has taken post-graduate work at the University of Delaware and Temple University, was until recently with the Hercules Powder Company as Personnel Superintendent of its Louisiana, Mo., plant. Prior to that time, he was Training Supervisor of its Radford, Va., plant.

Cunningham

Gheen Cunningham has been appointed Technical Representative of Harrison & Company, Inc., Haverhill, Mass., manufacturers of Harrison 4-A Buffing and Polishing Compounds. A University of Pennsylvania graduate, he is well grounded in the buffing and polishing field, having spent five years with du Pont as a technical field representative, as general foreman of a cutlery factory and as supervisor of mirror-finishing and polishing departments. With Harrison, he will be available for technical assistance on problems pertaining to polishing compounds and cement.

Dr. Bernard Agruss has recently accepted an appointment as research engineer in the Engineering Research Institute of the University of Michigan, Ann

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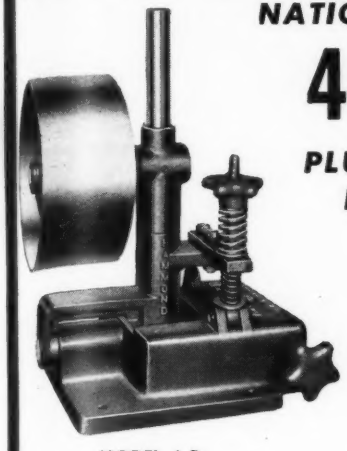

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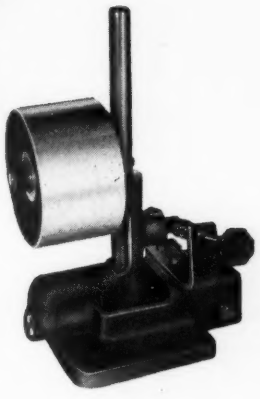

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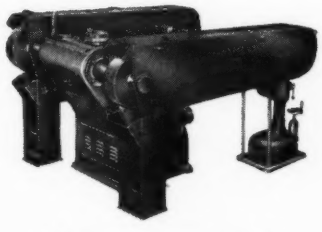

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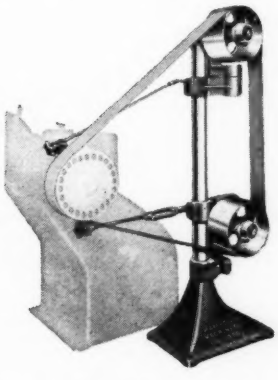

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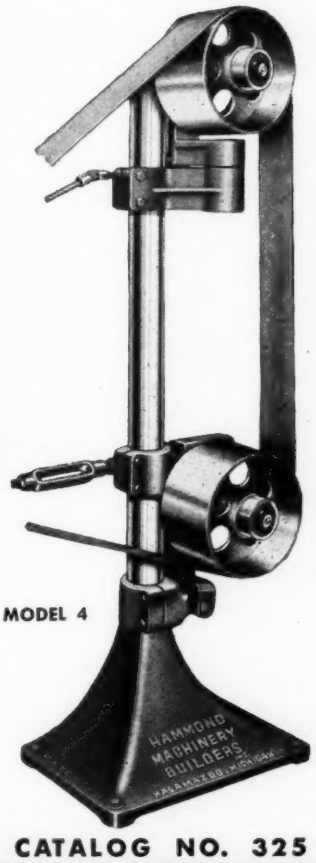

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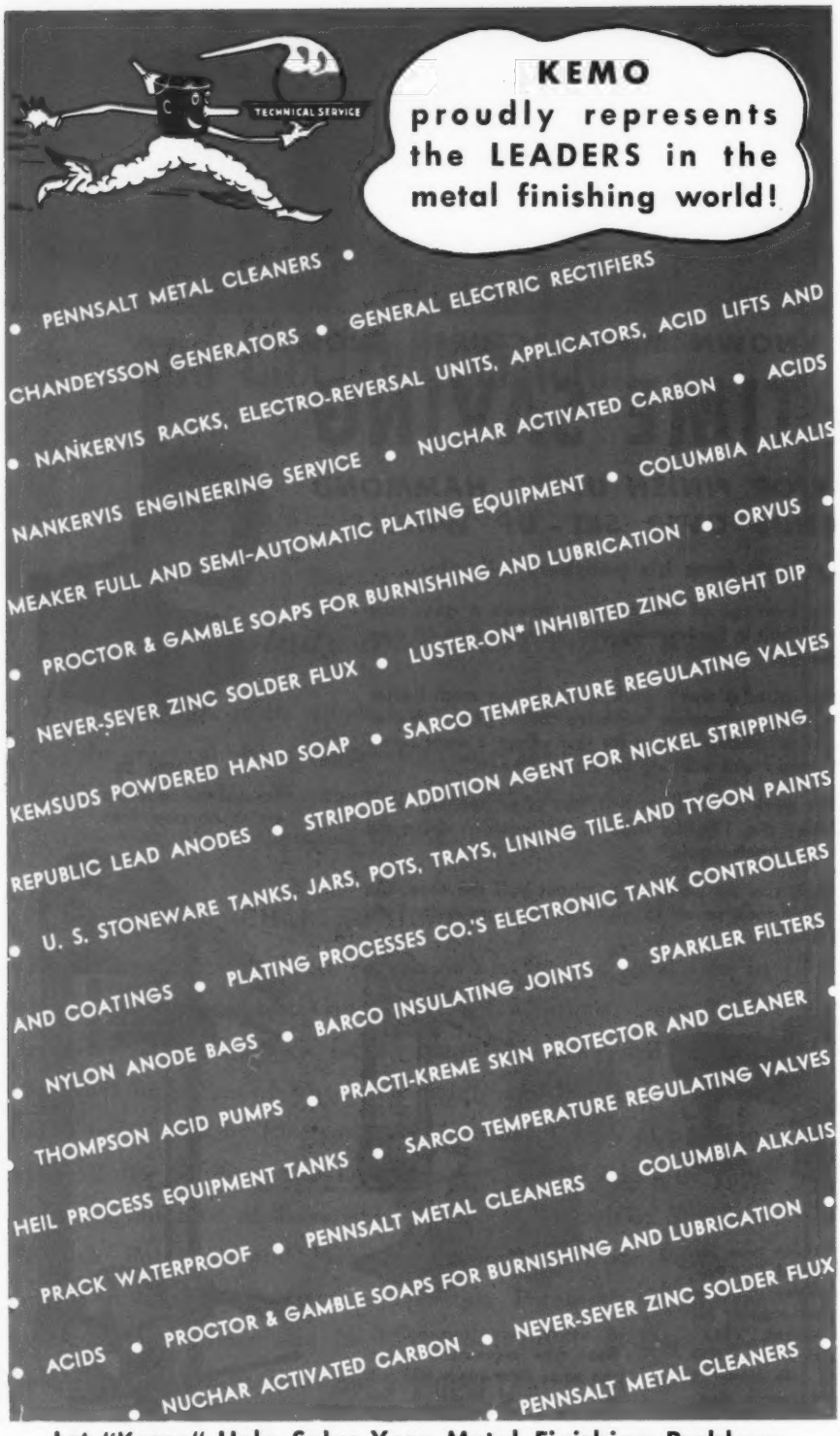
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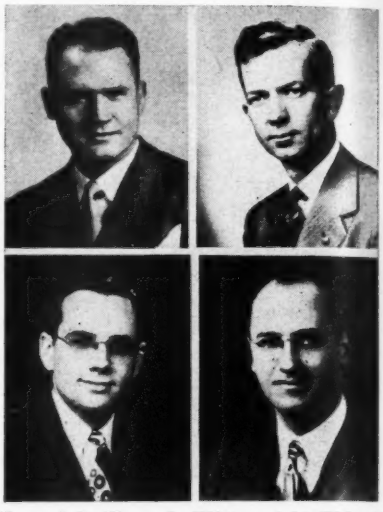
Personals

Arbor, Mich. He was formerly associated with Battelle Memorial Institute in Columbus, Ohio, where he served as secretary-treasurer of the Columbus Branch of the American Electroplaters' Society.



Upper left, Harry L. Flister; right, Eldon B. Hunt; lower left, John E. Vaughn; right, Roscoe K. Martin

Harry L. Elister, Eldon B. Hunt, John E. Vaughn, and **Roscoe K. Martin** are four additional Industrial Department Service Representatives who have been placed in the Cincinnati, Grand Rapids, Indianapolis and Pittsburgh offices of the Wyandotte Chemicals Corporation. All were assigned to their territories following intensive training in the Wyandotte Technical Service Laboratories and practical field work pertaining to metal finishing in several manufacturing centers.

Roscoe K. Martin, Cincinnati, has completed studies at the University of Dayton and has been a test engineer, chemist and plating analyst for Allison Division of General Motors and for Wright Field.

Eldon B. Hunt, Grand Rapids, is a chemical engineering graduate of Michigan State College. He has done experimental work in heat treating for Oldsmobile and in electronics for the Navy.

John E. Vaughn, Indianapolis, is a chemical engineering graduate from University of Kansas. He has been a development engineer for U. S. Rubber, a chemist for Seagram and an inspection officer for the Navy.

Harry L. Flister, Pittsburgh, is a graduate of the University of that city, and was employed by U. S. Steel following active service with the Navy.

Waldemar P. Ruemmler, formerly of Battelle Memorial Institute, Columbus, Ohio, has joined The Eagle-Picher Company as Development Engineer in East Chicago, Ind. Mr. Ruemmler has been a member of the Columbus Branch of the American Electroplaters' Society for the past three years.

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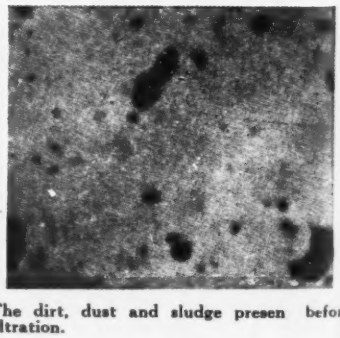

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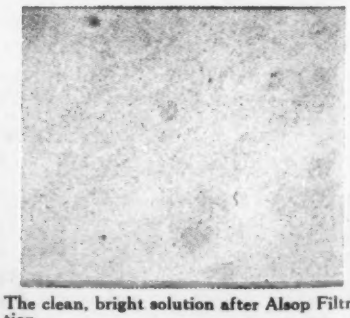

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WHAT IS RESEARCH?

RESEARCH IS A WORD loved by nearly all, the shop man as well as the engineer, not to forget the advertising man with a tooth paste or beauty preparation account. The only people who hesitate to use it are the research man who does the work and the company management which pays the bill. Next to awful and swell, it is probably the most abused word in the English language.

According to Webster's International, research is "a studious inquiry or examination, specifically and usually a critical and exhaustive investigation or experimentation having for its aim the discovery of new facts and their correct interpretation, the revision of accepted conclusions, theories, or laws in the light of newly discovered facts or the practical applications of such new or revised conclusions."

Hence research is very different from process or product control or from the occasional rough experiments which so often are graced with the name of research. Above all, it has nothing to do with ambiguous advertising claims.

The first step in research is the accumulation of data. Factual data are actually very elusive and to find them requires not only much patience but also well-developed techniques. The basic technique is to hold all known factors constant during an experiment except the one being studied. This often becomes a sizable undertaking because only by the application of statistical method can the experimenter assure himself that his values are meaningful, and statistics require a substantial number of determinations to be effective. It is when such controlled data give inconclusive results that research really turns interesting, especially when all known variables have been proven controlled and the researcher has to hunt for the unknown.

The true researcher, therefore, must be more than a systematic plodder—in fact, he must have a vivid imagination and a thorough acquaintance with fields of science other than his own on which his imagination can feed.

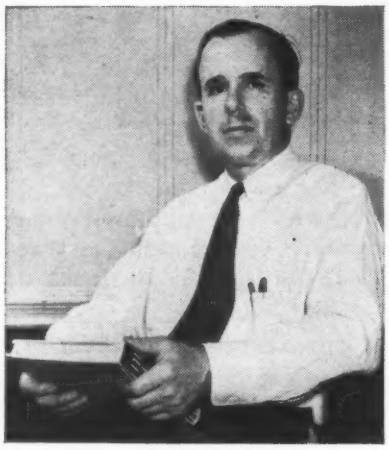
But data are not enough for that thorough understanding of a phenomenon which alone makes it generally useful. The data must also be interpreted and fitted into the general scheme of things which the scientist calls theory, another much abused word. Again turning to Webster, we find that a theory is "an hypothesis which has undergone verification" and an hypothesis is "a supposition provisionally adopted to explain certain facts and to guide in the investigation of others." There is, therefore, no inherent contradiction between theory and practice, only a bad hypothesis or tentative theory clashes with facts.

The growth of an art into a science is predicated on the development of theory which will fit a large number of independent and uncorrelated observations into a logical whole. The casual observation may have a temporary value in solving a difficulty, but since it depends on the existence of a particular set of circumstances, it is not generally applicable when a new set of circumstances come into being.

Good research which gives reliable results is always expensive although less expensive in the long run than hit-and-miss experimentation. Results cannot be expected overnight. The wise corporation executive, therefore, sees to it that the problem for investigation is one which gives promise of truly valuable results and tries to make certain beforehand that the complexities are not so great as to require a disproportionate outlay of money before results can be expected. He also knows that one man with a good brain and necessary equipment can accomplish more than a number of average people in the most completely equipped laboratory.

There are many important problems, the solutions of which do not bring immediate economic returns but are required in the development of economically worthwhile projects. Such problems can best be handled by joint action of interested parties. An outstanding example is the research carried out under the auspices of the American Electroplaters' Society. Most of the problems are of fundamental character, and their solution will provide the whole industry with new tools and fresh points of view which will prove of immense importance in the years to come.

Gustaf Soderberg



GEORGE DUBPERNELL

A graduate of the University of Michigan in 1924, where he was associated with the late Professor E. M. Baker, Dr. Dubpernell then worked and studied under Dr. Colin G. Fink at Columbia University and received the A.M. degree from that institution in 1927. Returning to Michigan, he studied under Professor A. L. Ferguson and received the Ph.D. degree in 1933 for work on overvoltage. His early experience with plating which began in 1919 included work on lead plating (Detroit Battery Company), zinc (Harris Zinc Process Company and Apollo Metal Works), copper and nickel (C. G. Spring & Bumper Company), and cadmium (The Udylite Corporation). He has been associated with the development of chromium plating since 1925, from 1933 on with United Chromium, Inc. in Waterbury, Conn., where he he is now Manager of the Waterbury Laboratory.

ELECTROPLATING RESEARCH

past and present

GEORGE DUBPERNELL
United Chromium, Incorporated, Waterbury, Conn.

ONE OF THE FIRST to study electrochemical effects extensively was the Italian medical student, Aloisio Galvani (1737–1798), whose results on the activation of frog's legs by electricity, published in 1791, were a landmark in electrochemical history. We still frequently refer to anything electrolytic as "galvanic", and electrochemistry was also known for many years as "galvanism". Zinc coated articles are called 'galvanized".

Allessandro Volta (1745–1827) was an Italian physicist. He examined many electrolytic cells in the period 1792–1797 especially, and the voltaic battery or voltaic pile soon came to be the common source of current. He did much to establish the electromotive force table of metals, and proposed that the point of contact between metals was the source of voltage in an electrolytic cell. This contact theory of electricity in cells was the focal point or storm center of much early work, but Faraday did a good deal to show that chemical action was required to produce an electirc current, in about 1833.

Georg Simon Ohm (1789–1854) was a German physicist. He discovered the well-known law which bears his name in 1826, but it is little known that he studied electrolysis extensively in establishing the laws of conduction, and his disclosure of "Ohm's Law" was in a paper entitled "The Electrolytic Cell, Mathematically Considered".

André Marie Ampère (1775–1836) was a French physicist who showed the connections between electricity and magnetism around 1822–1826, and the unit of current is named after him.

The electrodeposition of metals had its beginnings around 1800. According to Mottelay, Brugnatelli did some gold and silver plating in about 1802, and was a student of Volta. Two Swedish chemists, Berzelius and Hisinger, deposited a number of metals such as silver, copper, iron, and zinc, in an extensive study of the electrolysis of salts and other compounds published in 1803. Probably there was considerable experimenting with the electrodeposition of metals during the next twenty or thirty years, but the results were either unpublished or are largely unknown to the writer.

Michael Faraday (1791–1867) published the most important of his "Experimental Researches in Electricity" relating to electrochemistry in about 1833. He originated the term "electrode" for what had previously been called the "poles" of a cell, and also "anode", "cathode", "anion", "cation", "ion", "electrolyte", and "electrolyzed". He electrolyzed practically all of the chemical compounds known at the time, both

in solution and when fused. He deposited many metals such as gold, silver, copper, zinc, lead, tin, antimony, bismuth, etc., but was not interested in electroplating or the form of the deposit, and studied mainly the laws of electrolysis which bear his name. He made no effort to commercialize any of his discoveries, and stated that ". . . it is the great beauty of our science, Chemistry, that advancement in it, whether in a degree great or small, instead of exhausting the subjects of research, opens the doors to further and more abundant knowledge, overflowing with beauty and utility, to those who will be at the easy personal pains of undertaking its experimental investigation". This is still true and is characteristic of all research work.

From this time on (1833), workers on electroplating became increasingly numerous, patents were granted, books and articles were published, and commercial development began. This early activity is somewhat beyond the scope of the present article, but has been extensively reviewed by others[1].

We might mention a few other beginnings of electroplating as research brought forth new processes. Copper was said to be plated by Cruikshank in 1803, but acid copper, the first copper commonly used, only appears to have become more common after the introduction of the Daniell cell in about 1830 or shortly before. This cell had a zinc anode but deposited copper on the cathode from the acid sulfate solution. Jacobi noticed in 1830 in removing the excess copper from the cathode that it came off in layers and reproduced the cathode surface perfectly. This led to the development of electrotyping and electroforming ("galvanoplasty") which became a popular hobby of the last half of the 19th century.

Plating with cyanide solutions appears to have begun with the discovery of the silver cyanide solution by John Wright, a Birmingham surgeon, in about 1840, a hundred years ago. This was promptly patented by Elkington. Commercial work with gold and silver plating began immediately, and Wright received a royalty on all silver deposited under the patent. Cyanide copper plating appears to have begun at this time also, and Ruolz is stated to have developed brass plating in 1841. Russell and Woolrich patented a cyanide cadmium bath in 1849, and Watt a similar bath for zinc in 1855. However, cadmium plating was not utilized commercially to any great extent until about 1920 or shortly thereafter.

It is thus noteworthy that there was much research and commercial utilization of the processes of electrodeposition discovered in the period immediately following Faraday's work in the 1830's. Research is born of enthusiasm. To the writer, an outstanding characteristic of practically all of the early workers was their zeal. Electrochemistry and electroplating have been fortunate from the beginning in the self-sacrificing diligence of their devotees. There seems to be a fascination to observing the effects of an electric current passing through a solution which is never forgotten. One easily gets the feeling of being an explorer, of observing results and happenings never seen previously.

In spite of lack of knowledge, equipment, materials, and other conveniences, much of the early work is still very instructive. Many of the early workers electrolyzed solutions of practically all chemical compounds known at the time. Dr. Alfred Smee and Dr Isaac Adams, and probably others, gave up medica careers to devote their lives to electrodeposition work. Dr. George Gore in England did very extensive work and wrote at least four outstanding books on electrochemistry and electrodeposition in the period from 1850 to 1900, and yet the writer would venture a guess that probably not one in ten present-day American workers in electrodeposition is particularly familiar with his name or work.

The purpose for which some of the early work was done is generally lost sight of. Thus Junot de Bussy or Chaudron-Junot in France did what was apparently the first recorded work on chromium deposition in 1848 to 1855 using chloride solutions, but his purpose was to find an undercoat to facilitate the silver and gold plating of iron and steel articles, and he investigated many metals for this purpose. Dr. Anton Geuther, whom the writer seems to recall being described as a German pharmacist, studied the electrolysis of chromic acid in 1856 and was the first to report the deposition of metallic chromium from such a solution. However, his purpose was to disprove Faraday's Laws, and he thought he had succeeded. Dr. H. Buff showed that Geuther's tangent galvanometer was inaccurate, and thus discredited his work. As a result, everyone apparently also overlooked his discovery of chromium deposition from chromic acid for about forty or fifty years!

Many discoveries attract little or no attention if industrial conditions are not such as to lead to their commercialization. Dr. William Blum stated in 1928[2] that: "It is difficult to point to any important method of plating that was not at least known in essentially its present form twenty-five years ago". The use of hot, high-speed nickel solutions might be taken as a case in point. These have been credited to Alfred Levy of France, in 1906[3]. Brochet states that Foerster recommended hot nickel solutions in Germany in 1897. Dr. O. P. Watts published an outstanding paper in this country in 1916. However, it remained for the large scale development of the automobile industry and a demand for bright bumpers and other parts on cars to provide the conditions for the adoption of this type of nickel plating on a large scale by such workers as the late Prof. E. M. Baker, in the early 1920's. It then spread to England and France at a slightly later date.

Plating research appears to the writer to have been largely engendered by the profit motive, in addition to the enthusiasm of individual workers. Dr. Isaac

Adams of Boston established the nickel plating industry in 1869, in the United States, England and France, perhaps also in Germany, after about ten years of investigation. The process was widely licensed both here and abroad under the Adams patents. His United Nickel Company became involved in litigation, and his patents on the nickel ammonium sulfate solution and on cast nickel anodes were upheld.

The desirability and possibility of chromium plating had been clearly envisaged, but it was many years later, in 1923 and 1924, that the principles which control chromium plating were discovered by Dr. Colin G. Fink and Marvin J. Udy, working independently. Commercial application followed immediately. The patents granted led to the widespread use of chromium plating for both decorative and industrial purposes, and prompted still further research and development work, not only on chromium plating but also on closely related plating processes.

It seems that most applied research on plating and metal finishing is done in laboratories of industrial firms seeking to find a new process or product suitable for commercial development. Outstanding among these are such companies as the Aluminum Company of America, Bell Telephone Laboratories, Chrysler Corporation, E. I. du Pont de Nemours & Company (Inc.), General Motors Corporation, Hanson-Van Winkle-Munning Company, Harshaw Chemical Company, McGean Chemical Company, New Jersey Zinc Company, Seymour Manufacturing Company, The Udylite Corporation, United Chromium, Incorporated, and others.

Over a hundred U. S. patents are granted each year that are of important interest in the plating field, and about an equal number of foreign patents in various countries also. It is unfortunate that the number of patents and articles published each year has become so great that it is impossible for the research worker to keep familiar with them and have any time left for research. Under these conditions it has become increasingly important to improve and extend our indexes to the literature, such as Chemical Abstracts, The Metals Review, Industrial Arts Index, and so on. No one source is indexing the literature and patents in this field completely, and many publications appear which fail to come to the attention of those who should be familiar with them.

In addition to the substantial contributions to the advancement of plating made and being made each year by industrial firms in the plating field, there are also noteworthy contributions from various colleges and universities having strong departments of electrochemistry headed by capable and enthusiastic men. Examples are Fink at Columbia, Ferguson and Baker at Michigan, Bancroft at Cornell, Lukens at Pennsylvania, Mathers at Indiana, Watts at Wisconsin, Glasstone at Sheffield, Field in London, Foerster and Mueller at Dresden, Grube at Stuttgart, and so on. Industrial research institutes are coming to be more important contributors also, such as the Mellon Institute, Battelle Memorial Institute, and Arthur D. Little, Incorporated.

Government-supported research is also important and more likely to lead to fundamental discoveries. Typical of this is the work of our own National Bureau of Standards, headed by Dr. Blum, that of Macnaughtan and Hothersall at the Woolwich Arsenal in England, and of Liebreich at the Chemisch Technischen Reichsanstalt in Berlin.

Another important source of progress is society-sponsored research such as the present program of the American Electroplaters' Society. This again is more likely to lead to fundamental contributions than is industrial research. It is being conducted largely at colleges and universities, and with the number of enthusiastic workers involved, we can expect that in addition to the results sought there will also be "gains from serendipity". Serendipity may be defined as the happy faculty of making useful discoveries by accident or sagacity, of things which one was not originally seeking[4].

An outstanding new tool for research is provided in the radioactive isotopes of many metals which have been produced as a by-product of the atomic bomb work. Many metals which can be plated are now available in small quantities in radioactive form and are thus capable of being "traced" or followed through any series of reactions. An editorial suggests that the thickness and uniformity of the deposit might be checked conveniently by means of the co-deposition of minute amounts of radioactive metals[5].

With the vast amount of work being done it would seem as if the time had arrived for further noteworthy progress in both electrochemistry and electroplating. Theoretical electrochemistry and the theory of solutions do not seem to have progressed to a substantial degree since Arrhenius propounded the theory of ionization in 1887. In a recent paper Dr. G. E. Gardam stated that ". . . theoretical electrochemistry is less fruitful than would be expected" and ". . . is not yet capable of dealing usefully with the necessarily complex solutions and dynamic conditions of practical metal deposition". In the discussion to this paper, A. W. Hothersall ". . . agreed on the inadequacy and unreality of classical electrochemical theory as applied to electrodeposition". When advances in theory are made, we may expect to see many further remarkable new plating and finishing processes developed which are as yet not even foreseen for the most part.

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STRESS DATA ON COPPER DEPOSITS FROM ALKALINE BATHS

A. KENNETH GRAHAM* AND ROBERT LLOYD†

SINCE THE senior author first observed the extent to which edge cracks and surface check cracks occur on copper-nickel-chromium and nickel-chromium coatings over steel in outdoor exposure, considerable data have been published on stress in nickel deposits[1,2,3]. Because copper is extensively used as an undercoat for nickel-chromium deposits, the authors have undertaken to determine the magnitude of the internal stress in copper deposits from alkaline baths. It is believed that these data may ultimately help to explain some of the failures of the copper-nickel-chromium coatings and possibly lead to improved quality.

The stress determination was by the usual procedure, the copper plate being deposited from one liter of bath with cathode rod agitation upon a flat, annealed copper cathode 2.5 x 0.5 x 0.002 inch. A copper plate thickness of 0.25 mil was deposited from each of the baths except that which contained 75 ppm lead. From the latter bath a copper plate thickness of 0.1 mil was deposited since the stress in the deposit from this bath was of such magnitude that a 0.25 mil deposit caused the cathode to be stressed beyond its elastic limit. The time required for a given thickness of plate was determined on the basis of the cathode current efficiency of the copper bath in question, measured under the exact conditions of cathode and anode current densities, temperature, and agitation employed in the determination of stress.

The Soderberg-Graham general stress equation[1] was used for calculating the stress in the copper deposits. By inserting in it the values for the thickness of the copper base (0.002 inch) and of the copper deposit (below) and assuming the modulus of elasticity for both base and deposit to be 15.6 x 10^6 psi, the general equation was reduced to the following simple forms:

(1) For 0.00025 inch copper deposit:

$$S = 150.5 \frac{1000}{r}$$

(2) For 0.0001 inch copper deposit:

$$S = 305 \frac{1000}{r}$$

where S = stress in copper deposit in psi.

r = radius of curvature of plated specimen in cm

The thermal coefficient of expansion was considered to be identical for the copper base and the copper deposit. Under these conditions and taking the proportional limit for the copper base to be 5000 psi, the maximum stress measurable with accuracy is about 14,500 and 29,000 psi for the 0.00025 and 0.0001 inch deposits, respectively.

The cathode efficiencies and stress values reported in Table I were determined at a *p*H of 12.5, a temperature of 160° F, a current density of 20 asf, and with rod agitation, unless otherwise noted under the "variables studied". Similarly, the bath composition was maintained at 4 oz/gal copper, 0.8 oz/gal rochelle salt and 4 oz/gal sodium carbonate, unless otherwise noted.

The standard bath and standard conditions in test No. 1 give a cathode efficiency of 87.3 per cent and a deposit with 8,700 psi contractile stress.

Tests Nos. 2 to 5 show the effect of variations in the operating conditions. Surprisingly, current reversal, using an 8-second cathodic–2-second anodic cycle, gives a relatively high contractile stress of 11,600 psi, and the cathode efficiency is appreciably lowered due to lost plating time and deplating during the anodic periods of the cycle. No attempt will be made to explain this observation, since more data are needed

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TABLE I. STRESS IN COPPER DEPOSITS FROM ALKALINE BATHS

Test No.	Cathode Efficiency Per Cent	Stress[1] in Deposit 1000 psi	Variables Studied
1	87.3	8.7	Standard[2]
2	53.7	11.6	Current reversal[3]
3	73.0	14.7	cd, 40 asf
4	82.5	11.5	Temperature, 130° F
5	91.0	5.8	Temperature, 180° F
6	95.0	6.4	No rochelle salt
7	78.1	9.0	Na_2CO_3, 9 oz/gal
8	86.0	9.0	Free NaCN, 1.6 oz/gal
9	87.0	8.6	NaOH to *p*H 13.0
10	88.4	9.7	Copper, 2.5 oz/gal
11	88.0	8.0	Copper, 5.0 oz/gal
12	88.0	8.4	$CaCO_3$, 100 ppm
13	86.1	8.6	$K_4Fe(CN)_6$, 0.5 g/l
14	85.2	8.8	$K_4Fe(CN)_6$, 1.0 g/l
15	87.2	11.3	Lead, 2 ppm
16	90.3	15.4[4]	Lead, 75 ppm
17	90.0	− 4.0	KCNS, 2 oz/gal
18	95.3	− 4.7	KCNS, 2 oz/gal, no rochelle salt
19	98.5	3.1	A[5]
20	98.9	3.6	A, lower *p*H
21	92.8	7.8	A, lower temperature
22	93.0	11.1	B
23	95.2	− 5.0	C
24	88.0	− 3.8	D

[1]Contractile stresses, positive; expansion stresses, negative. Average of 3 to 4 determinations.
[2]Standard conditions: 12.5 *p*H; 20 asf; 160° F; rod agitation; coating thickness 0.00025 inch.
Standard bath: Copper, 4 oz/gal; free NaCN, 0.8 oz/gal; rochelle salt, 4 oz/gal; Na_2CO_3, 4 oz/gal.
[3]Cycle: 8-second cathodic, 2-second anodic. Current density 20 asf.
[4]Coating thickness 0.0001 inch.
[5]Letters A, B, C and D stand for proprietary baths operated at the vendors' recommended conditions, except as noted.

to establish clearly the relationship between current reversal and stress in the deposit.

Where operating conditions are the only variables, there appears to be a clear-cut relationship between the effects of current density and temperature upon the cathode efficiency and the stress in the deposit. An increase in current density or a decrease in temperature both reduce the cathode efficiency and raise the contractile stress in the deposit. It is significant that the contractile stress in the deposit increases from 5,600 to 14,700 psi as the cathode efficiency decreases from 91.0 to 73.0 per cent. It is believed that variation in the hydrogen evolved during plating may be related to the stress changes noted.

Tests Nos. 6 to 11 show the effects of variations in the bath composition. Omission of the rochelle salt reduces the contractile stress to 6,400 psi. Increasing the *p*H to 13.0 or the free cyanide to 1.6 oz/gal causes little change in the cathode efficiency and no significant change in the stress. Increasing the sodium carbonate from 4 to 9 oz/gal, however, lowers the cathode efficiency to 78.1 per cent but produces no appreciable change in the stress in the deposit. Equally unexplainable is the observation that the stress appears to increase slightly as the copper concentration is lowered from 4 to 2.5 oz/gal and to decrease somewhat as the copper concentration is raised from 4 to 5 oz/gal, in spite of no significant change in the cathode efficiency.

Tests Nos. 12 to 18 show the effects of impurities or addition agents in the copper bath. Increasing the calcium carbonate hardness to 100 ppm or the addition of potassium ferrocyanide up to a concentration of 1.0 g/l produces no significant change in the cathode efficiency or the stress in the deposit. The addition of 2 and 75 ppm of lead, as lead acetate increases the contractile stress in the deposit to 11,300 and 15,400 psi respectively even though the cathode efficiency is increased to 90.3 per cent at the higher concentration. The deposits are of course brightened by the lead additions. On the other hand, while the addition of 2 oz/gal of potassium thiocyanate also brightens the deposit, it profoundly alters the stress to an expansive value of -4,000 psi with only a slight increase in cathode efficiency to 90.0 per cent. In the absence of rochelle salt, the same addition of thiocyanate gives an expansive stress of -4,700 psi and a cathode efficiency of 95.3 per cent.

Values of cathode efficiency and stress for pro-

(Continued on page 506)

LEADERS IN THE INDUSTRY . LEADERS IN THE INDUSTRY . LEADERS IN THE INDUSTRY .

Mechanical Properties of Nickel Deposits

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In the first report[1] on this work results were given for the influence of pH, solution temperature, current density, annealing temperature and time on the hardness, tensile strength and ductility of nickel deposits prepared from the all-chloride and from a typical Watts plating bath. In the present report the effects of pH on these mechanical properties are given for as-plated and annealed deposits from Watts baths of several compositions. The baths employed were: low-boric-acid, low-chloride, low-total-composition.

Experimental

The solution compositions are given in Table I. Ten liters of each were prepared and purified by the methods given in the previous article, the low-total-composition solution being prepared by dilution of the standard bath. A temperature of 130° ± 0.5° F was used; stratification in the baths was prevented by gentle mechanical stirring, *p*H (electrometric) control was at ±0.05 units of the indicated values, anode bags and frequent filtration were employed, and hydrogen peroxide additions were made according to the solution *p*H as indicated earlier. A current density of 50 asf was used at *p*H 2 to 3, and 40 asf at *p*H 4 to 5.6.

Deposits about 0.03 inch thick or thicker were obtained in non-adherent form on a 6 x 2½ x 0.03 inch stainless steel cathode. The anodes were 2 inches wide and were placed two on each side of the cathode, with a 2½-inch anode-to-cathode spacing and with a one-inch space between adjacent anodes. With this arrangement and with the long axis of the cathode in a horizontal position, the deposit thickness was slightly less at the center, so that the break occurred near the center of the tensile specimen. In most cases six specimens were obtained from each run, which were machined into tensile specimens 6 x ½ inch with a 1½ x ¼ inch reduced section. The specimens were tested as indicated previously, and the reported Vickers hardness numbers are again for the outer surface of the deposits. Annealing was carried out as stated earlier.

Results

The results of the mechanical tests are given in Figs. 1 to 6; the data for the standard bath are those reported before. As a check on the results previously gotten for the effect of annealing temperature, the data of Fig. 7 were obtained for deposits from the low-chloride bath and are compared with the pertinent data for the standard bath; a maximum annealing temperature of about 1400° F was again found.

Discussion

As-plated deposits from the standard, low-boric-acid and low-chloride solutions show the same general trends. With increase in *p*H, the ductility rises to a maximum at *p*H 4 to 4.5, after which it falls rapidly with the standard and low-chloride solutions and less rapidly with the low-boric-acid solution. The dilute bath shows the lowest ductility, with a minimum at *p*H 4 to 4.5, but at high *p*H the values are higher than those for the standard and low-chloride baths. The maximum elongation, 37 per cent, was obtained from both the standard and the low-chloride baths at *p*H 4.5 (Fig. 1.) The tensile strength and hardness values for the deposits show the reverse trends. With the low-chloride, low-boric-acid and standard baths there is a minimum at *p*H 4.5, while the dilute bath shows a maximum at *p*H 4.0. The maximum hard-

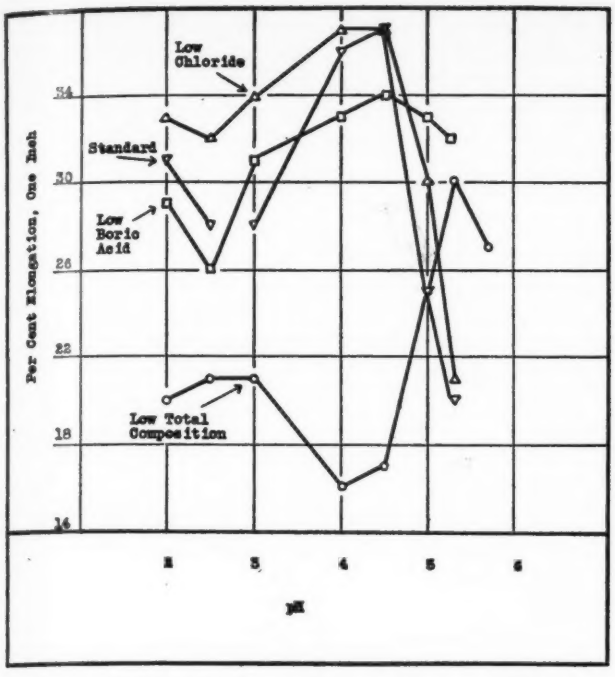


Fig. 1. Effect of pH on Elongation of As-Plated Deposits

ness, 214 VHN, was obtained from the standard bath at *p*H 5.3 (Fig. 2), and the maximum tensile strength, 97,000 psi, under the same conditions (Fig. 3).

The same general effect of *p*H was found in the annealed deposits: an increase in ductility to a maximum at about *p*H 4.5, with a corresponding decrease in hardness and tensile strength to a minimum at about the same *p*H. The difference in behavior of deposits from the dilute bath was not as pronounced in the annealed as in the as-plated condition (Figs. 4 to 6).

Behavior on Bending

A deposit 0.001 inch thick was prepared from the standard Watts bath at *p*H 4.5, 130° F, 50 asf on a 0.01 inch thick steel basis metal. Part of the specimen was annealed for 15 minutes at 1400° F, and then both as-plated and annealed pieces were bent flat on a piece of the steel and examined under the microscope for failure. Photomicrographs of the sharp bends in the specimens are shown in Fig. 8. The as-plated deposit showed necking and failure. The comparatively rough edge of the severely deformed section of the annealed deposit was typical of a number of areas examined and appears to be due to the large grain size of the deposit. Annealing at a lower temperature, or of a deposit plated at a higher *p*H, will give a finer grain size and the deposit may still be sufficiently ductile to withstand the severe bend without necking.

Reactions at the Cathode

From *p*H 2 to 5 there is little difference in the hardness values for deposits from the standard, low-boric-acid and low-chloride solutions, but the low-total-composition solution shows quite a different behavior. The fact that there is no simple relation between the standard and the dilute baths indicates the probable complexity of the relationships between the various factors involved.

Tucker[2] increased the boric acid content of the Watts bath from 15 to 60 g/l with only a slight increase in the hardness, and this appears to have been confirmed over a wide *p*H range in the present work.

The results obtained by Blum and Kasper[3] indicate that, with 25 per cent of the nickel present as chloride, the deposits were as hard as those from an all-chloride bath. Tucker[2] found that when the nickel as chloride was increased from 6 to 25 per cent there was only a slight increase, but above this value the hardness definitely increased. In the present standard bath 14 per cent of the nickel was present as chloride, while in the low-chloride bath the value was 4 per cent, so that no great change in hardness would be anticipated.

The grain size of a deposit is regulated by three rates: the rate of nucleus formation, the rate of growth parallel to the cathode surface, and the rate of growth normal to the surface. At low current density the growth rate of nuclei should exceed the formation rate and larger grains should result. The present data[4] show no change in hardness with current density for as-plated deposits at *p*H 2 while at *p*H5 the hardness increased with decrease in current density.

TABLE I. SOLUTION COMPOSITIONS

Constituents	Concentration, g/l			
	Standard	Low-Boric-Acid	Low-Chloride	Low-Total-Composition
Nickel sulfate	325	325	325	163
Nickel chloride	45	45	11	22
Boric Acid	30	10	30	15
Nickel (as Ni)	79.3	79	69	39
Chloride (as Cl)	13.4	13.6	3.2	6.6

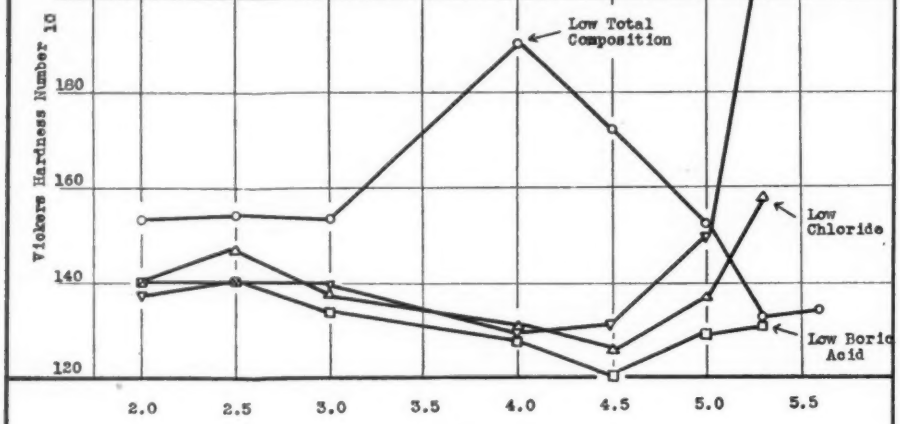


Fig. 2. Effect of pH on Hardness of As-Plated Deposits

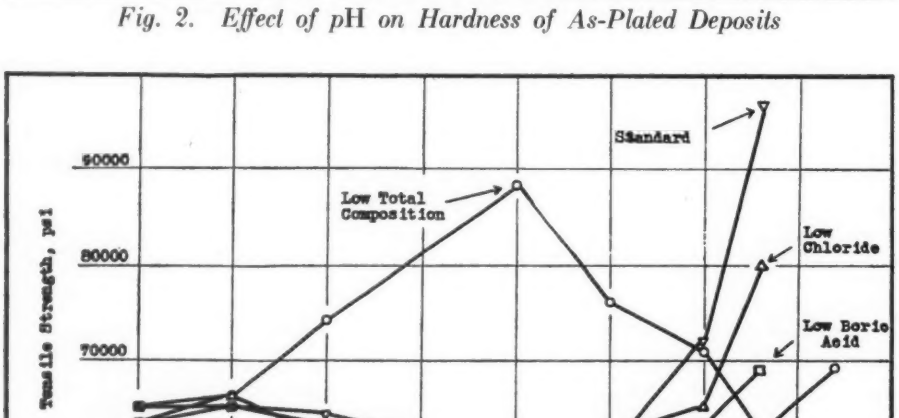


Fig. 3. Effect of pH on Tensile Strength of As-Plated Deposits

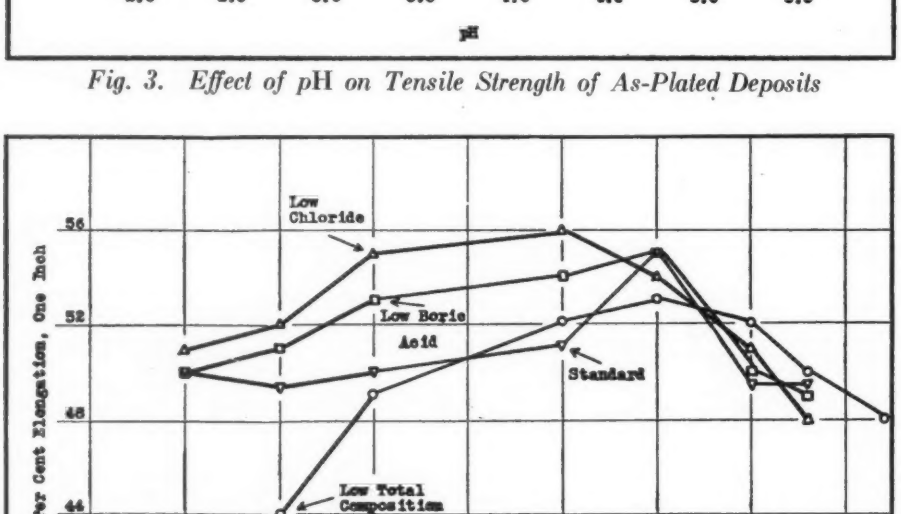


Fig. 4. Effect of pH on Elongation of Annealed Deposits

It has been found[5] that at *p*H 5.3 and 140° F an increase in current density in a sulfate bath decreases the hardness of the nickel deposits (apparently the opposite effect exists at 68° F), but in a chloride bath the reverse occurs. A similar result was obtained[6] with cadmium from sulfate and chloride baths. It has also been found[7] that, with a sulfate-chloride nickel bath containing potassium, the grain size of the deposit passes through a maximum at 15 asf over a current density range of 1 to 50 asf. Above certain limits the chloride content of a nickel bath is a factor influencing the hardness and, under certain conditions, the bath temperatures can reverse the effect of current density. The picture is further complicated by Tucker's data[2], which indicate that the hardness shows a regular increase when the nickel content as chloride is increased from 6 to 36 per cent i the total nickel content is increased at the same time.

As to the effect of metal ion concentration, the opinion ha been expressed that a high concentration is a favorable condition for the formation of fresh nuclei, while other work[8] has shown that the number of nuclei decreases with increase in concentration. Dilution of the standard bath produced an increase in hardness in the *p*H range from 2 to 4, but above this value there was a sharp drop in hardness, and at *p*H 5 the deposits were much harder from the standard than from the dilute bath.

In 1928 Schlotter formulated the rule that the structure o electrolytically produced metals is strongly influenced by the anion present, using as a point in his argument the work o Muller and Barchmann[9] in which cadmium deposits from a chloride solution were found to be coarsely crystalline while those from

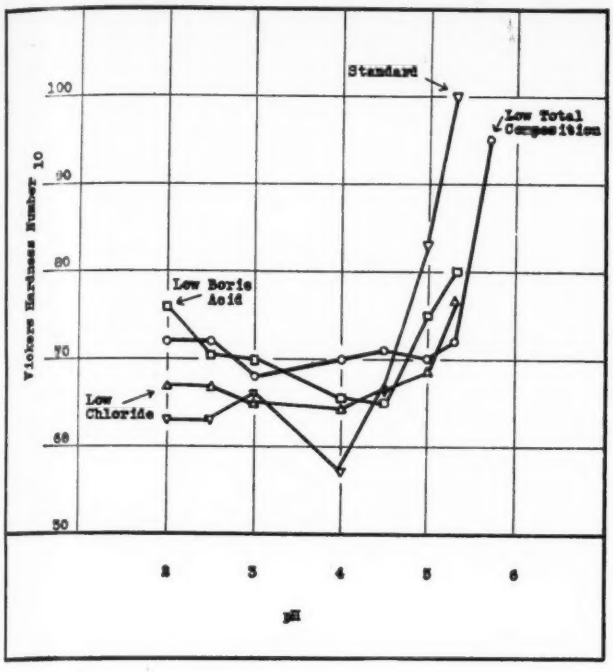


Fig. 5. Effect of pH on Hardness of Annealed Deposits

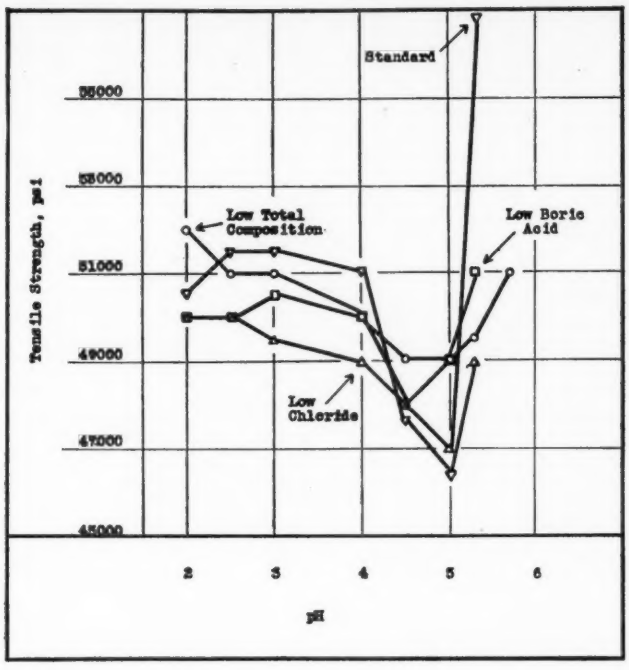


Fig. 6. Effect of pH on Tensile Strength of Annealed Deposits

sulfate solution had no visible crystalline structure. Wernick found[10], however, that the grain size of the deposit from a cadmium sulfate bath was quite dependent on the bath *p*H, the grain size decreasing as the *p*H was increased. The Watts nickel bath behaves in a similar manner[11], giving deposits with fairly large grain size at *p*H 1.75 and much finer grains at *p*H 5.3, while the all-chloride nickel bath deposits are fine-grained over a wide *p*H range. Although generalizations such as Schlotter's may be of considerable value, it should be recognized that other factors, such as *p*H, must be considered and controlled.

It has been suggested[12] that the hardness of nickel deposits is associated with the colloidal behavior of basic nickel salts, formed in the cathode film during plating. A number of factors may have both direct and indirect effects on this behavior—temperature, current density, *p*H, cathode efficiency, presence of other anions and of various cations, etc. Graham's data[13] indicate that the difference in concentration between the bath and the cathode film for nickel and chloride is influenced by the bath concentration; any study of hardness relationships should thus include determinations of ionic concentrations in these two regions. Although the data are insufficient at present to substantiate the point, it appears likely that the ratio of chloride to sulfate ion concentration will be an important factor.

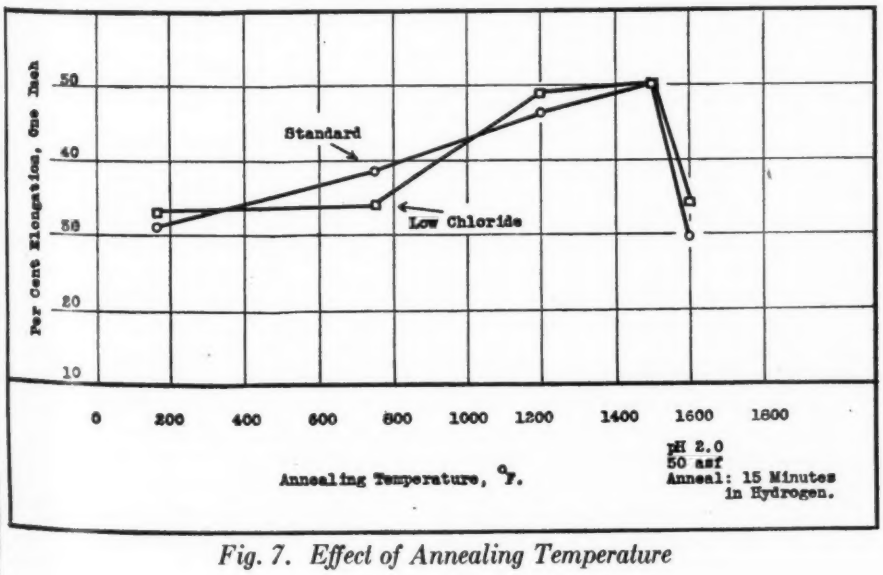


Fig. 7. Effect of Annealing Temperature

Conclusions

As-plated deposits from the standard, low-chloride, and low-boric-acid baths all show a maximum elongation at a *p*H of about 4.5; the dilute bath shows quite a different behavior, with a maximum at *p*H 5.3. The hardness and tensile strength values are at a minimum at these points.

The greatest observed as-plated elongation, 37 per cent in one inch, was that of deposits from both the standard and low-chloride baths at *p*H 4.5.

Annealed deposits from all of the baths show a maximum duc-

(*Continued on page 478*)

1948 A.E.S.

CONVENTION AND INDUSTRIAL FINISHING EXPOSITION

Atlantic City, N. J. — June 28 to July 1

The program for the 35th Annual Convention of the American Electroplaters' Society and the Industrial Finishing Exposition, sponsored by the Society's Newark Branch, is now taking final form.

TECHNICAL PROGRAM

There will be five educational sessions, on Monday and Wednesday afternoons and on Tuesday, Wednesday, and Thursday mornings. Four sessions will be devoted to general papers on electroplating and allied processes, and one to the presentation of the findings of some of the Research Projects carried on by the Society through its Research Committee.

The following papers have been offered to the Papers Committee, Mr. Myron B. Diggin, Hanson-Van Winkle-Munning Company, Chairman. The Committee plans to accept for the Convention the sixteen papers which in its judgment are best suited to oral presentation and to offer the others to the Editors of PLATING for publication in this journal.

"A Circulating Electrolyte Cell for Strip Plating Evaluation" by R. A. Dimon, Carnegie-Illinois Steel Corporation

"Bright Barrel Plating of Nickel and Zinc" by Leonard A. Chesworth, United-Carr Fastener Corporation, Cambridge, Mass

"The Deposition of Metals on Plastics Employing Reduced Copper Films" by Harold Narcus, Electrochemical Industries, Inc., Holyoke, Mass.

"Practical Methods of Cost Finding and Estimating on Metal Finishes" by Adolph Bregman, Consultant, New York City

"Bronze Plating" by U. A. Mullin, Wright Aeronautical Corporation, Paterson, N. J.

"The Electroplaters' Metals of the Future" by F. A. Lowenheim, Metal & Thermit Corporation, Rahway, N. J.

"Barrel Plating" by Austin Fletcher, Enthone, Inc., Binghamton, N. Y.

"Description, Design and Production Costs of a Conveyorized Spray Finishing System" by E. Paul Swartz, L. C. Smith-Corona Typewriter Corporation, Syracuse, N. Y.

"Industrial Electropolishing" by Charles L. Faust, Battelle Memorial Institute, Columbus, Ohio

"The Importance of Acid Ratio in Phosphatization of Steel" by Nelson F. Murphy and Michael A. Streicher, Virginia Polytechnic Institute, Department of Chemical Engineering, Blackburg, Va.

"Diaphragm Tanks to Eliminate Roughness in Copper Plating" by R. W. McGahan, C. E. MacKinnon and D. A. Swalheim, E. I. du Pont de Nemours Company, Inc., Electrochemicals Division, Wilmington, Del.

"The Spiral Contractometer, a New Instrument for the Measurement of Stress in Electrodeposits" by Abner Brenner and Seymour Senderoff, National Bureau of Standards, Washington, D. C.

"Oxidation of Trivalent Chromium in Chromic Acid Plating Baths" by Robert Seegmiller and Vernon Lamb, National Bureau of Standards, Washington, D. C.

"Metal Cleaning" by George B. Hogaboom, Consultant, New Britain, Conn.

"Alkaline Electrocleaners; Their Relation to the Properties of Subsequent Bright Decorative Plating" by H. R. Friedberg, The Radiant Corporation, Cleveland, Ohio

"Plating Copper-Zinc Alloys" by A Kenneth Graham, Graham, Crowley and Associates, Jenkintown, Pa.

"Electropolishing of Silver" by Daniel Gray, Oneida, Ltd., Oneida, N. Y.

"Judging the Quality of Plated Parts" by William M. Phillips and F. L. Clifton, Research Laboratories, General Motors Corporation, Detroit, Mich.

"Surface Finish Standards" by J. M. Cosgrove, B. O. Q., N. O. T. S., Inyokern, Calif.

"Engineering Planning in the Plating Room" by S. M. Martin, United Chromium, Inc., New York City

The A. E. S. Research which has recently produced some very significant results is represented by four outstanding contributions which are scheduled to be given on Wednesday morning.

"Some Effects of Copper as an Impurity in Nickel Solutions and Its Effect on Salt Spray Resistance of Nickel-Chromium Plate on Steel" by D. T. Ewing and Robert Rominski (Project No. 5)

"Determination of the Porosity and Corrodibility of Electrolytic Metal Foils" by N. Thon and Mr. D. Kelemen (Project No. 6)

"Effects of Stress on Chemical Methods for Determining the Thickness of Electrodeposits" by Harold J. Read (Project No. 7)

"Physical Properties of Nickel Deposits" by Abner Brenner and Charles W. Jennings (Project No. 8)

INDUSTRIAL FINISHING EXPOSITION

The leading manufacturers of equipment and supplies will have large displays illustrating recent advances in electroplating, polishing and buffing, cleaning,

degreasing, washing and rinsing, and a variety of surface treatments.

Many pieces of automatic equipment will be seen, some in actual operation.

Specialized instruments, racks and masking devices, corrosion resistant materials, generators and rectifiers, filters and pumps are a few of the plating auxiliaries to be exhibited.

The Exposition will be open on Monday from 12 Noon to 10 P. M., on Tuesday and Wednesday from 10 A. M. to 10 P. M., and on Thursday from 10 A. M. to 5 P. M.

Admission is free and will be by tickets supplied by Exhibitors or by Convention badges. Visitors who have neither but have a legitimate interest in the Exposition may register at the Exposition and obtain complimentary tickets there.

A few booths are still available on a "first come, first served" basis, according to Messrs. George Wagner and Howard Bobb, Exposition Co-Chairmen. All booths are supplied with electric power and may be furnished with other services, such as water, compressed air, and steam. Exhaust vents are available in some booths (see floor plan in February issue). Further information may be had by application to Mr. George Wagner, 35 Fourth Street, Newark 7, N. J.

Platers' Exhibit

In addition to the industrial exhibits, a number of individual members and Branches of the American Electroplaters' Society will exhibit a variety of finished articles illustrating outstanding applications of new and old processes and techniques. In many cases these exhibits of commercial and special finishes will be accompanied by description of the process steps taken.

Entertainment Features

The International Fellowship Club, an organization of supply house representatives with Mr. T. Trumbour of Metal Finishing Publications, Inc., as Permanent Secretary, will sponsor an Open House for all registered Convention visitors in the Ball Room of Ambassador Hotel on Monday evening. This party offers an excellent opportunity to renew old friendships and make new ones. There will be music, dancing, presentation of special awards, and a buffet luncheon.

Another Fellowship Club affair is the Annual Golf Tournament under the chairmanship of Mr. J. J. Duffy, Jr., of Pennsylvania Salt Manufacturing Company, which is scheduled for Tuesday afternoon. Unsuccessful attempts will be made to settle many old rivalries.

The climax of the social activities will be the Banquet arranged by the Program Entertainment Committee, Paul A. Oldam, Chairman, on Thursday night. An eight-girl review, five variety acts, will supply real Atlantic City entertainment, and there will be dancing until 2 P. M. to the music of the Conventionaires.

Ladies' Program

In addition to the general entertainment there will be a special program for the ladies put on by the Ladies' Committee under the chairmanship of Mrs. A. P. Munning. It includes a card party on Monday; Dave Clarin's "Aunt Ella's Party," sponsored by Oakite Products, Inc., on Tuesday; a luncheon at Golf Club on Wednesday, followed by an International Fellowship Club bingo party with Joan Trumbour Wiarda as hostess. A visit to the Steel Pier is planned for the evening of the same day.

Other Attractions

There is much in Atlantic City to attract the attention of the Convention visitor during his free time: excellent facilities for sunbathing and swimming, boating and horseback riding, the boardwalk along the ocean with fine restaurants and interesting auctions, and a gay night life.

Registration

The registration desk will be located in the main lobby of Hotel Ambassador, Convention Headquarters. It will be open on Sunday, June 27, at 3 P. M. and every day of the Convention. The registration fee is $8.00 per person, which entitles the registrant to a book of tickets for every function.

Hotel Reservations

All reservations should be made directly to Hotel Ambassador, Atlantic City. Reservation cards have been sent to all members of the Society.

Group Travel

Arrangements have been made with the Pennsylvania Railroad to provide special cars to Atlantic City providing at least fifteen people wish to travel together from any of the following cities: Atlanta, Ga.; Baltimore, Md.; Boston, Mass.; Buffalo, N. Y.; Chicago, Ill.; Cincinnati, Ohio; Cleveland, Ohio; Columbus, Ohio; Dayton, Ohio; Detroit, Mich.; Grand Rapids, Mich.; Los Angeles, Calif.; Milwaukee, Wis.; Minneapolis, Minn.; Montreal, Quebec; Newark, N. J.; New Haven, Conn.; New York City; Philadelphia, Pa.; Pittsburgh, Pa.; St. Paul, Minn.; San Francisco, Calif.; St. Louis, Mo.; Toledo, Ohio; Toronto, Ont.; Washington, D.C. See your P. R R. District or Dvision Passenger Agent.

a. e. s. research project no. 2

project director:
EARL J. SERFASS

associate:
W. S. LEVINE

location:
LEHIGH UNIVERSITY,
BETHLEHEM, PA.

in collaboration with
G. Frederick Smith
Frederick Duke

Acknowledgement is due the Research Committee, Dr. R. M. Wick, Bethlehem Steel Company, Chairman; the Research Directing Committee, Dr. Louis Weisberg, Consulting Chemist, New York City, and Dr. C. Fred Gurnham, Consulting Chemical Engineer, Waterbury, Conn., Chairman and Vice-Chairman, respectively; and the Project Committee, Dr. D. Gardner Foulke, Hanson-Van Winkle-Munning Company, Chairman; Dr. Walter R. Meyer, Enthone, Inc., and Dr. Henry B. Linford, Columbia University, for their contribution to this project.

Determination of Impurities in Electroplating Solutions

VII. TRACES OF CADMIUM IN NICKEL PLATING BATHS

Introduction

The seventh article in this series of investigations of the colorimetric determination of trace elements in nickel plating baths is concerned with cadmium. As before, the method desired is one that will be applicable in the presence of appreciable quantities of lead, iron, chromium, silicon, manganese, copper, zinc, aluminum, and calcium.

A literature survey for methods that have been used for determining cadmium in nickel baths proved fruitless. Also, no references were found for determining cadmium in any type of plating bath except cadmium baths.

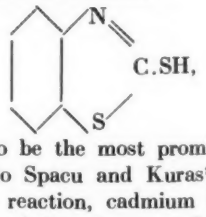
The number of reliable colorimetric methods for determining cadmium is not large. The dithizone method described by Fischer and Leopoldi[2,6] would be satisfactory for this work except for the fact that the cadmium cannot be separated from the nickel by this method even when it is first precipitated as cadmium pyridine thiocyanate.

Small amounts of cadmium can be quantitatively separated from nickel as the sulfide from slightly acid solutions when a collector such as copper is used[1]. Cadmium can be determined by precipitation as colloidal cadmium sulfide and comparison of the colloidal suspension, which can be gelatin stabilized, with a standard. The method is made more sensitive if ultra-violet radiation instead of daylight is used to contrast the suspension and the standard[3,4]. However, appreciable quantities of lead would interfere in the analysis of cadmium by this method which, therefore, could not be considered further.

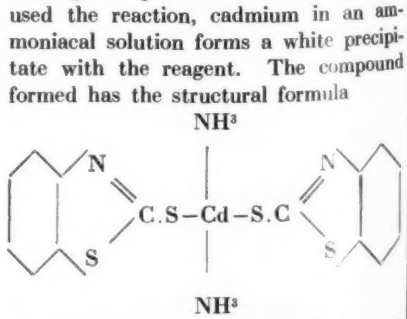
Developmental Work

If cadmium could be separated from nickel, the dithizone method could be used to determine cadmium. Of the other ions, in the presence of which the cadmium method is to be applicable, only copper and lead will seriously interfere, and their interference can be eliminated. Copper can be removed along with any iron by precipitating it with cupferron and extracting the cupferrides with amyl acetate. Lead interference is prevented by extracting the cadmium from a strongly alkaline solution from which lead is not extracted by dithizone.

To find a method of separating cadmium from nickel, a number of reactions of these ions with various organic reagents were reviewed. Of these reagents, 2-mercaptobenzothiazole,



seemed to be the most promising. According to Spacu and Kuras[8] who first used the reaction, cadmium in an ammoniacal solution forms a white precipitate with the reagent. The compound formed has the structural formula



according to Prodinger[5]. Nickel does not form a precipitate with 2-mercaptobenzo-

thiazole in an ammoniacal solution, and while any lead present will be precipitated along with the cadmium, it need not do any harm as pointed out above.

Spacu and Kuras used the reagent to precipitate several hundred milligrams of [illegible] but it was found that as little as 10 micrograms in a volume of 10 ml could be precipitated with it. Additional work showed that the separation of cadmium from nickel could be completed by extracting the cadmium (and lead) mercaptobenzothiazole with chloroform. It was found to be the best of a number of water immiscible solvents tested for extracting the cadmium precipitate.

To bring the cadmium and any lead present back to an aqueous medium, the chloroform extract is shaken with 6-*N* hydrochloric acid. From this point, the determination of cadmium can be completed according to the Fischer and Leopoldi method[2] by extracting the cadmium from a strongly alkaline solution with a carbon tetrachloride solution of dithizone and measuring the extinction or per cent transmission of the solution after dilution to a suitable volume with carbon tetrachloride.

Thus a tentative procedure was evolved consisting of the following steps:

1. Any copper and iron present are removed by precipitation with cupferron and extraction with amyl acetate.

2. The aqueous solution is made ammoniacal, the cadmium precipitated with mercaptobenzothiazole, and the precipitate is extracted with chloroform.

3. The cadmium is extracted from the chloroform with 6-*N* hydrochloric acid, enough sodium hydroxide added to make the solution strongly alkaline—about *p*H11—and then the cadmium is extracted with dithizone.

In order to determine whether the tentative procedure was capable of giving quantitative results, 10 micrograms of cadmium were placed in a separatory funnel, 1 ml 6-*N* hydrochloric acid, 20 ml *N* sodium hydroxide added and the cadmium extracted with dithizone solution. The extractions were diluted to 50 ml with carbon tetrachloride and the transmittancy of the solution measured in the manner described under "Recommended Routine Procedure". The reading obtained was considered the "theoretical reading". Then, if a similar quantity of cadmium was carried through the proposed procedure and a similar reading obtained, all the added cadmium would have been recovered.

When this was done, about 90 per cent of the added cadmium was found. However, when 1 ml of a pure synthetic Watts type plating bath containing about 90 milligrams of nickel was added to the cadmium, only about 40 per cent of that added was recovered. In addition, a small amount of nickel was still found to be present in the solution after the chloroform extract had been shaken with the hydrochloric acid. A checkup revealed that most of the cadmium loss took place when the chloroform extract was being washed with distilled water in order to remove small quantities of nickel in the water droplets which were suspended in the organic solvent. The cadmium seemed to be extracted from the chloroform layer by the water wash. This occurred only when nickel was present, and not in its absence.

After a great deal of experimental work, it was found that the loss of cadmium could be eliminated by washing the chloroform extract with an ammoniacal solution of 2-mercaptobenzothiazole. The 2-mercaptobenzothiazole seems to be the effective agent in preventing the return of the cadmium to the aqueous layer. However, even with this washing mixture, a trace of nickel sometimes came through. The addition of dimethylglyoxime before the sodium hydroxide precipitated the trace of nickel and prevented it from being extracted by dithizone along with the cadmium.

TABLE I RECOVERY OF CADMIUM BY NEW PROCEDURE

Theoretical reading	63
Observed reading	56

With these changes incorporated into the procedure, cadmium recovery was much better. In Table I are compared the theoretical reading with that obtained when 10 micrograms of cadmium was mixed with 1 ml of the synthetic plating bath and the mixture analyzed for cadmium following this procedure. It is seen that about 90 per cent of the added cadmium is recovered. The 10 per cent lost seems to be due to slight losses in each of the many steps in the procedure.

Preparation of Calibration Curve

Because the results obtained are reproducible and the small amount of cadmium lost is proportional to the quantity present, the procedure is still suitable for a colorimetric method.

The calibration curve is prepared by making a series of successive runs with 0, 10, 20, 30, 40, and 60 micrograms of cadmium respectively in the presence of 1 ml of the synthetic nickel bath following the recommended routine procedure given near the end of this paper. The readings are shown in Table II. Beginning with 40 micrograms of cadmium, the blanks become progressively higher because more extractions are required to remove all the cadmium. Three 5-ml additions of dithizone are sufficient for amounts of cadmium up to 30 micrograms. If necessary, additional extractions are made with 2-ml portions of dithizone until the last one is colorless or has a light yellowish brown color instead of the bright red color due to cadmium dithizonate.

By plotting the mean average readings against the corresponding amounts of cadmium, the calibration curve shown in

TABLE II. CALIBRATION CURVE DATA

Cadmium microgram	Colorimeter Readings	Average Reading	Blank	Corrected Average Reading	Mean Average Reading
0	19–18–19	18	..	..	..
10	69–67–67	68	18	50	
10	75–75–72	74	18	56	53
10	71–72–68	70	18	52	
20	120–118–115	118	18	100	
20	122–122–122	122	18	104	104
20	128–122–126	125	18	107	
30	172–170–172	171	18	153	153
40	208–206–206	207	18	189	
40	208–210–206	208	20	188	188
40	212–204–206	207	20	187	
60	286–282–284	284	24	260	
60	290–298–288	292	24	268	265
60	288–296–292	292	24	268	

Fig. 1 is obtained. The fact that it is not a straight line shows that Bouguer-Beer's law is not obeyed by the colored system over the concentration range tested. This law, however, seems to be followed to about 30 micrograms of cadmium since the curve is practically linear to this point. Fischer and Leopoldi[2] in their original work studied the colored system up to a concentration of 33.3 micrograms of cadmium and found that Bouguer-Beer's law was followed over this concentration range.

Since there existed the possibility that not all the cadmium was being extracted by dithizone or that not all the cadmium was being extracted by one portion of hydrochloric acid from the chloroform solution at the higher concentrations, a few tests were run in which 40, 50, and 60 micrograms of cadmium were extracted from a strongly alkaline solution with dithizone. These runs also indicated that Bouguer-Beer's law was not being followed at these concentrations.

The calibration curve data was obtained with a Klett-Sommerson colorimeter using the green filter No. 54 sold with the instrument. If one employs an instrument having a wave length selector, it should be set at about 520 millimicrons since the transmittancy curve for the cadmium dithizonate system (Fig. 2, curve A) shows that its absorptiveness is at a maximum for light of this wave length. If any other filter colorimeter is used, the filter selected should be such that its maximum transmission band corresponds as closely as possible to that most strongly absorbed by the colored system. Curve B in Fig. 2 is the transmittancy curve of the filter used in this study and should be compared with that of the cadmium dithizonate solution (curve A in Fig. 2). The data for the transmittancy curves in Fig. 2 were obtained with a Beckman Spectrophotometer.

Accuracy and Precision Attainable

The accuracy with which cadmium can be determined in nickel baths with this procedure is illustrated by the following work.

To check the accuracy attainable under conditions similar to those that might be met in plating practice, a commercial bath was simulated by dissolving small amounts of various salts in 100 ml of a synthetic Watts type plating bath and analyzing for cadmium in the presence of these impurities. Table III shows the ions and the quantity of each that were added.

These ions were added as the solid chlorides, sulfates, or nitrates wherever possible. All the salts dissolved except that of calcium. The solution was heated, shaken well, and cooled. It was then filtered to remove the insoluble calcium salts, and the filtrate was used for the accuracy and precision tests.

With [illegible] used in preparing the calibration curve, Table IV shows results obtained on single runs.

The average error in these tests is 3.7 per cent, the greatest error 6 per cent. Hence, if the procedure is being followed closely, it should not be too difficult to attain an accuracy of about 6 per cent.

An additional check on the accuracy of the method resulted from sending samples of a test solution to several companies for analysis by the procedure developed. The concerns which kindly consented to do this work were the Bethlehem Steel Company of Bethlehem, Pa., Hanson-Van Winkle-Munning Company of Matawan, N. J., and the Chrysler Corporation of Detroit, Mich. The test solution was prepared by adding enough cadmium to 100 ml of the impure synthetic bath used above to give the bath a concentration of 20 milligrams per liter. Their results and those obtained by the writers are shown in Table V.

To illustrate the precision of the method, five duplicate samples containing 20 micrograms of cadmium were run. The results are shown in Table VI.

The precision of the method is fair, and the errors of individual runs about the same as that found in the accuracy tests. The average value for the amount of cadmium found is 19.7 micrograms, which is a good check.

Recommended Routine Procedure

The following is the procedure finally adopted and recommended for the determination of cadmium in nickel plating baths.

Solutions Required

1. Cupferron, 1 per cent solution
   Dissolve 1 g reagent in water and dilute to 100 ml. The solution should be kept cold and prepared fresh daily.
2. [illegible] solution
   Dissolve 1 g reagent in 100 ml absolute alcohol. Prepare the solution fresh each day.
3. Amyl acetate, purest grade
4. Chloroform, purest grade
5. Sodium hydroxide, 1-*N* solution
   Dissolve 40 g C.P. reagent in enough water to make 1 l.
6. Hydrochloric acid, abt. 6-*N* solution
   Mix 98 ml conc. hydrochloric acid with 102 ml water.
7. Dithizone, abt. 0.01 per cent solution
   Dissolve 0.1 g purified dithizone in carbon tetrachloride, dilute to 1 l and overlay the solution with 10 per cent hydroxylamine hydrochloride. Keep the solution in a cool, dark place to retard oxidation of the reagent. The dithizone can be puri-

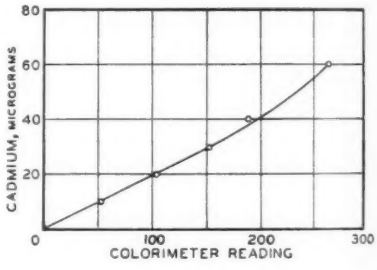


Fig. 1. Calibration curve for determination of cadmium in nickel plating baths (Watts type bath used) by dithizone method. Instrument used: Klett-Sommerson colorimeter with green filter No. 54. Cell: test tube. Final volume of solution: 50 ml

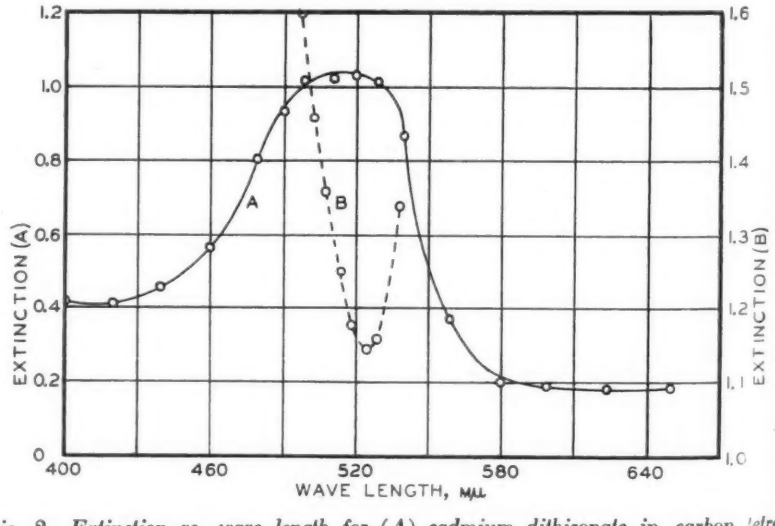


Fig. 2. Extinction vs. wave length for (A) cadmium dithizonate in carbon tetrachloride, 60 micrograms cadmium in 50 ml, (B) Klett-Sommerson green filter No. 54 (extinction units on the right)

fied by the method described by the authors in their article on the determination of lead[7].

8. Carbon tetrachloride, C.P. grade
9. Ammonium hydroxide, C.P. grade
10. Dimethylglyoxime, 1 per cent solution
    Dissolve 1 g of the reagent in absolute alcohol and dilute to 100 ml. This solution should also be prepared daily.
11. 2-Mercaptobenzothiazole – ammonium hydroxide wash solution
    Mix 10 ml of the 1 per cent mercaptobenzothiazole solution with 10 ml concentrated ammonium hydroxide and dilute to 100 ml with water.
12. Tartaric acid, 50 per cent solution
    Dissolve 10 g reagent in water and dilute to 20 ml. Keep in a dropping bottle if one is available.
13. Standard cadmium solution, 10 micrograms/ml
    Dissolve 100 mg pure cadmium in 1 ml conc. hydrochloric acid and dilute to 1 l. Pipette 10 ml of this stock solution into a 100-ml volumetric flask, dilute to the mark and shake.
14. Synthetic Watts-type plating bath
    Dissolve 330 g cryst. nickel sulfate, 45 g cryst. nickel chloride, and 30 g boric acid in pure distilled water and dilute to 1 l. Filter to remove any insoluble matter that may be present.

Apparatus Required

1. Separatory funnels—Squibb type of about 60–100 ml capacity
2. Burettes
3. Pipettes
4. Graduates
5. 50-ml volumetric flask
6. Klett-Sommerson Colorimeter with green filter No. 54
   Any suitable photoelectric colorimeter or spectrophotometer may be used if the proper filter or wave length are selected.
7. Funnel and No. 31 Whatman filter paper
8. 50-ml Erlenmeyer flask

Procedure

A. Separation of Copper and Iron

1. Pipette 1 ml of the bath into a separatory funnel.
2. Add 5 ml of cold water and 1 ml of chilled cupferron solution. Shake well for about 30 seconds.
3. Add 5 ml amyl acetate. Shake well for 30 seconds. After the layers have separated cleanly, run the aqueous layer into a second clean separatory funnel.
4. Repeat step 3 with the aqueous layer in the second separatory funnel and run the aqueous solution into a third separatory funnel.
5. Combine the two amyl acetate extracts in the first and second funnels, add 5 ml water, shake for 30 seconds, and after the layers have separated, run the wash solution into the third funnel containing the sample and discard the amyl acetate extracts.

B. Precipitation of the Cadmium

6. Add two drops 50 per cent tartaric acid and 1 ml conc. ammonium hydroxide. The solution should be fairly alkaline.
7. Add 1 ml mercaptobenzothiazole reagent and shake for about 1 minute.
8. Add 10 ml chloroform and shake vigorously for 1 minute. Allow the layers to separate and run the chloroform extract into a fourth

TABLE III. IONS ADDED TO NICKEL BATH

Ions	Quantity mg	Equivalent g/l
Aluminum	100	1.0
Chromate (as CrO_3)	20	0.2
Copper	20	0.2
Iron (as Fe^{+3})	100	1.0
Lead	5	0.05
Manganese	100	1.0
Silicate	100	1.0
Zinc	100	1.0
Calcium	(Saturated)	(Saturated)

TABLE IV. ACCURACY OF METHOD

Cadmium Added microgram	Colorimeter Readings	Average Reading	Blank	Corrected Average Reading	Cadmium Found microgram	Per Cent Error
10	69–67–67	68	17	51	10.0	0
20	110–112–112	111	17	94	18.8	−6.0
30	165–161–161	162	17	145	28.7	−4.3
50	250–248–248	249	20	229	48.7	−3.3
60	288–284–284	285	24	261	57.5	−4.2

TABLE V. RESULTS OBTAINED BY DIFFERENT LABORATORIES

Laboratory	A	B	C	D
Cadmium mg/l	18	19	20	18

TABLE VI. PRECISION OF METHOD

Cadmium Added microgram	Colorimeter Readings	Average Reading	Blank	Corrected Average Reading	Cadmium Found microgram	Per Cent Error
20	112–110–112	111	17	94	18.8	−6.0
20	125–122–122	123	17	106	20.8	+4.0
20	125–120–120	122	17	105	20.7	+3.5
20	112–108–111	110	17	93	18.6	−7.0
20	120–117–118	118	17	101	19.7	−1.5

clean separatory funnel. (The first and second funnels may be cleaned and used on this and the following operations.)

9. Repeat step 8 with the aqueous layer in the third separatory funnel and run the chloroform extract into the fourth funnel as in step 8. Discard the aqueous layer.

C. Isolation of the Cadmium

10. Add 10 ml mercaptobenzothiazole-ammonium hydroxide wash solution to the chloroform extracts and shake vigorously for 15 seconds. After the liquid layers have separated cleanly, run the chloroform layer into a fifth clean separatory funnel. If there is any solid matter present, take it along with the chloroform solution. Discard the aqueous layer.
11. Repeat step 10 two more times, each time throwing away the aqueous wash solution.
12. Add 1 ml 6-*N* hydrochloric acid and shake the mixture vigorously for about two minutes.
13. Then add 10 ml water and shake well for about another minute. Allow the layers to separate and discard the chloroform layer.

D. Development of the Colored System

14. Add 2 ml dimethylglyoxime solution and shake for 30 seconds. Allow the mixture to stand for 1 minute.
15. Run 20 ml normal sodium hydroxide into the separatory funnel. Shake for 30 seconds and allow the solution to stand for about a minute to allow any nickel present to precipitate.
16. Add 5 ml dithizone solution, shake for 30 seconds, allow the liquid layers to separate, and then run the extract into a 50-ml volumetric flask.
17. Repeat the extractions with dithizone on the aqueous layer until the extract comes through colorless or has a light yellowish brown color. If more than three extractions are required, the subsequent extractions are made with 2-ml portions of dithizone.
18. Dilute the combined extracts in the 50-ml flask with pure carbon tetrachloride, shake well to mix, and then run the solution through a clean Whatman No. 31 filter paper. Catch the filtrate in a clean 50-ml erlenmeyer flask.

E. Measuring the Transmittancy of the Solution

19. Using a test tube cell partially filled with carbon tetrachloride as the reference liquid, adjust the colorimeter so that the galvanometer pointer is at its zero position when the dial reading is zero. If the instrument used has a wave length selector, set it at 520 millimicrons.
20. Pour the carbon tetrachloride out of the test tube, rinse it out about twice with small portions of the test solution and then partially fill the tube with it.
21. Put the test tube back in the colorimeter and rotate the dial until the galvanometer reading returns to its zero position.
22. Simultaneously with the sample run a blank following exactly the same procedure except that no nickel bath aliquot is taken. Use as many extractions with dithizone on the blank as are necessary to extract all the cadmium from the unknown sample.
23. Subtract the blank reading from the sample reading to get a corrected measure of the amount of light transmitted by the solution. This method of correcting the blank can be used only when the scale readings of the instrument give the extinction of the sample directly or are related to the extinction.
24. Look up the corrected scale reading on the calibration curve; the amount of cadmium corresponding to it is the quantity of cadmium in the volume of bath originally taken for analysis.

Calculations

Suppose that 1 ml of a plating bath has been analyzed for cadmium using the procedure just described and that a reading of 250 has been obtained. Also, assume the blank reading to have been 20. How much cadmium is present in ppm?

The corrected scale reading is 250 − 20 = 230. According to the calibration curve (Fig. 1), this corrected scale reading corresponds to 49.3 micrograms of cadmium. Hence, there are 49.3 micrograms of cadmium in 1 ml of the plating bath or 49.3 ppm since micrograms per ml equals parts per million.

Discussion

When copper and iron have been removed, the *p*H of the solution should be around 2.6. If the solution is strongly acid, ammonium hydroxide should be added to bring it to about this value.

One must be careful not to add too little or too much ammonium hydroxide prior to the addition of the mercaptobenzothiazole. In either case, not all the cadmium will be precipitated. The use of 2 ml of ammonium hydroxide will give low results while about 6 drops of the reagent is just barely enough to give good results.

The tartaric acid is used to prevent the precipitation of ions that form hydrous oxides such as manganese which can result in the formation of a fairly stable emulsion when the cadmium is being extracted with chloroform.

The dimethylglyoxime is used to precipitate trace quantities of nickel that come through from time to time. It should be prepared fresh each day. Erratic results have been obtained when old solutions of the reagent were used.

It is of the utmost importance that all apparatus used in handling the dithizone extracts—funnel, volumetric flask, Erlenmeyer flask, and test tube cells—be well cleaned and tightly stoppered when not in actual use. Cadmium dithizonate is easily decomposed by even dilute acids and enough acid fumes can be absorbed on glassware standing open in the laboratory to cause partial decomposition of the compound. Failure to watch this factor will lead to erratic results. Any apparatus that has been used for cyanide solutions must not be used as a container for any of the solutions employed here, particularly those used after the extraction of the cadmium with hydrochloric acid, unless it has been cleaned very thoroughly.

Since the required number of extractions will affect the value of the blank, the blank must be given the same number of extractions as are required to extract all the cadmium from the sample.

Applicabilty of Method

The method has been tested on chloride, 50–50, and high sulfate baths as well as on Watts type baths and found to give satisfactory results.

Stop and Go Procedure

A "Stop and Go" procedure for the estimation of cadmium without the aid of a colorimeter was developed along the lines of the above recommended routine procedure. Since the technique was somewhat involved, it has been omitted from this paper. Work is continuing in the laboratory on the development of a simplified "Stop and Go" method for cadmium.

Summary

Copper and iron are removed by precipitation with cupferron and extraction of the cupferrides with amyl acetate. Cadmium is separated from the nickel by precipitation with 2-mercaptobenzothiazole in an ammoniacal solution and the precipitate is extracted with chloroform. The cadmium is returned to an aqueous medium by shaking the chloroform extract with 6-*N* hydrochloric acid. The solution is made strongly alkaline with sodium hydroxide solution and the cadmium extracted with a carbon tetrachloride solution of dithizone. After dilution to 50 ml, the extinction of the colored system is measured using light of about 520 millimicrons in wave length or a suitable filter.

Stripping of Copper

IV. THE SODIUM POLYSULFIDE-SODIUM CYANIDE METHOD

Introduction

The third report on this project was published in the September, 1946 issue of The Monthly Review. It covered the use of calcium polysulfide and sodium cyanide for stripping of copper. A summary of this article is presented below for the benefit of the reader:

"Agricultural" lime sulfur, having a sulfur content of approximately 24 per cent and a Baume reading of 32 to 33°, was found satisfactory as a low cost substitute for the calcium polysulfide solutions usually employed.

The optimum operating conditions for the sulfide treatment were established as:

1. Concentration—70 per cent by volume of lime sulfur, 30 per cent by volume of water.
2. Temperature—85° C ± 5° (185° F ± 9°).
3. Time of immersion—3 to 5 minutes.

The lime sulfur has little or no effect on carbon steel or malleable iron.

The sodium cyanide solution used (120 g/l, 16 oz/gal) should be operated warm for maximum efficiency. The use of a water jet for removal of the copper sulfide film in order to conserve cyanide was tried. Because the sulfide film was tightly adherent, little beneficial effect was noted.

The present report covers the extension of this work to include the use of sodium polysulfide.

Experimental

The original work with sodium polysulfide was conducted with a solution comparable in concentration to that found to be optimum for calcium polysulfide. Such a solution contained 66 oz/gal of sulfur and 40 oz/gal of sodium hydroxide. A small amount of a wetting agent, stable in alkaline solutions, was used to hasten the dissolution of the sulfur. Both USP and commercial grades of sulfur were employed in the early studies, but there appeared to be little difference in the results obtained. The polysulfide solutions were maintained at 85 to 90° C (185 to 194° F) throughout most of these experiments.

The studies indicate that the rate of formation of copper sulfide is higher in calcium polysulfide solutions than in sodium polysulfide solutions for short periods of immersion (2 to 5 minutes). At least 0.001 inch penetration was obtained in 2 minutes in both dilute and concentrated solutions of sodium polysulfide. However, over longer periods of immersion (10 minutes or more), the total amount of copper sulfide formed is approximately the same in the sodium polysufide solution as in the calcium polysulfide solutions.

The copper sulfide film formed in sodium polysulfide solutions was less adherent than that formed in calcium polysulfide solutions. By employing a strong water jet for rinsing, it was possible to dislodge approximately 80 to 90 per cent of the copper sulfide formed in sodium polysulfide. Under similar conditions, only 40 to 50 per cent of the copper sulfide formed in calcium polysulfide was removed.

Tests with more dilute solutions of sodium polysulfide gave improved results. The rate of formation of the copper sulfide was about the same as in concentrated solutions, and the film was more brittle and more easily removed by a strong water jet. By this means, about 90 to 98 per cent of the sulfide film was removed. The sodium hydroxide content was varied in these studies from 30 g/l (4 oz/gal) to 300 g/l (40 oz/gal), and the sulfur from 100 g/l (13.4 oz/gal) to 300 g/l (40 oz/gal).

Little difference in stripping rates or in physical characteristic of the film was noted over this wide range, except in those cases in which there was a considerable excess of sodium hydroxide. On the other hand, dilute solutions of calcium polysulfide gave poor penetration and a rather adherent copper sulfide film.

In large scale copper stripping operations, the use of dilute sodium polysulfide solutions followed by a power spray rinse

a. e. s. research project no. 1

project director:
F. C. MATHERS

associate:
E. L. MARTIN

location:
UNIVERSITY OF INDIANA,
BLOOMINGTON, IND.

Acknowledgment is due the Research Committee, Mr. C. E. Heussner, Chrysler Corporation, Chairman; the Research Directing Committee; Dr. R. M. Wick, Bethlehem Steel Company, and Dr. Louis Weisberg, Consulting Chemist, New York City, Chairman and Vice-Chairman, respectively; and the Project Committee: Mr. L. E. Weeg, C. G. Conn Ltd., Chairman; Mr. L. C. Borchert, Houdaille-Hershey Corporation, and Dr. H. J. Wiesner, C. G. Conn Ltd., for their contribution to this project.

might have some economic advantages by conserving cyanide. In order to evaluate properly this potential advantage over calcium polysulfide, plant tests under production conditions would be required.

a. e. s. research

Application of Sodium Polysulfide to Zinc Base Die Castings

The treatment of zinc base die castings presents a somewhat different problem from that of iron articles. Iron is very inert in both sulfide and cyanide solutions, whereas zinc base alloys are corroded or dissolved to an appreciable extent, particularly by cyanide solutions.

The stripping technique for die castings should take these factors into account so that the time of immersion in the cyanide solution is a minimum.

For the sulfide treatment, sodium polysulfide solutions were employed because it had previously been proven that the copper sulfide film could be almost completely removed with a strong water jet. The immersion time in sodium cyanide solution was therefore greatly reduced, and the amount of corrosion was minimized.

Tests showed that it was desirable to immerse the part in the sodium polysulfide solution for sufficient time to convert *all* the copper to copper sulfide. Where thin films of copper remain, requiring a second immersion in the polysulfide, the second film is not readily removed with a water spray.

Since die castings are also attacked by strong alkalies, the proportion of sodium hydroxide to sulfur is also important. A polysulfide solution composed of 100 g/l (13.4 oz/gal) of sodium hydroxide and an equal amount of sulfur produced little attack on unplated die castings after an immersion of 3 hours at 85° C. These concentrations were considered to be optimum. As the ratio of sodium hydroxide to sulfur was increased, the attack on the basis metal also increased.

For the treatment in sodium cyanide solution, tests indicated a marked decrease in the corrosion of the zinc base die casting when considerable quantities of sulfide were present. Assuming a corrosion rating of 100 for a new solution of sodium cyanide (120 g/l, 16 oz/gal), the rating for a solution of equal cyanide concentration but saturated with sulfide was 5. The data show little difference in results obtained at 25° C or 85° C. Further tests indicated the optimum concentration of sodium cyanide to be 60 g/l (8 oz/gal). Under these conditions, there remained on the surface of the die casting only a light film, which could be easily removed in dilute hydrochloric acid.

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Conservation of Tin

TIN IS AT PRESENT under world allocation and administered by the World Tin Committee. "Since the fulfillment of requirements for the defense of the United States has created a shortage in the supply of tin for defense, for private account and for export," Conservation Order M-43, as amended August 5, 1947, "is deemed necessary and appropriate in the public interest and to promote the national defense, etc."

This order provides under Schedules of Permitted Uses, Schedule I—Miscellaneous, (3) Foil: "(a) Pig or secondary tin may be used to make—(1) Electrotypers' foil if the tin content by weight of the foil is no greater than 30 per cent". The order also provides under "(14) Chemicals, (a) General: Tin or tin chemicals may be used for . . . plating (where plating is permitted by Order M-43)".

The use of electrodeposited tin coatings 0.0002 inch or less in thickness as a substitute for tin foil in backing electrotype shells with type metal has been found to give more uniform tinning and better quality electrotypes with a saving in both time and the amount of tin consumed.

The following illustrates the possible saving in tin: The 0.00125 inch thick 30-per cent tin foil commonly used is equivalent to 0.274 oz of tin per sq.ft. An electrodeposited tin coating of 0.0002 inch thickness, however, requires but 0.122 oz of tin per sq.ft. representing a saving of 0.152 oz of tin for every sq.ft. of electrotype surface so treated. Since it is frequently necessary to overlap the foil in backing electrotype shells of varying dimensions and double layers of foil are commonly used in practice, the actual saving would be still greater.

In spite of this saving of tin the administrators of Conservation Order M-43 appear to be unwilling to permit tin plating for this purpose because it is necessary to supply tin to the "pipe line" in the form of tin anodes and plating chemicals. This attitude is not justified in view of the quick recovery of tin through the savings. A Conservation Order is intended to conserve a material, not to perpetuate an existing use at the expense of an improvement effecting conservation.

It should not be necessary to canvass the industry to determine the number of installations required, as has been suggested, nor to withhold allocation of tin for this purpose. The indicated savings are real and clearly demonstrable as scientific facts. If the tin required for plating electrotypes were taken from the foil manufacturer's quota and given to the electrotypers it should be possible to save at least 55 per cent of the tin now being consumed for this purpose.

The Question Box

a department devoted to readers' questions of general interest —with authorative answers by associate editors

Q. 18. We are bright nickel plating thin brass strip and encounter an apparent hydrogen embrittlement of the brass strip causing the plated strip to break on slight deformation. Will you please tell us how we can overcome this hydrogen embrittlement?

A. Brass is not embrittled by hydrogen deposited cathodically. You are evidentally getting a sandwich effect as a result of applying hard, relatively brittle nickel plate on top if a soft ductile metal. When the strip is deformed, the nickel cracks and these cracks are propagated through the brass. The result, therefore, is that the brass appears embrittled. The cure for the disease is to use a ductile nickel, or if possible to increase the gauge of the brass being plated.—WALTER R. MEYER.

Q. 19. What advantage, if any, would there be in plating chain in a hot bright-nickel solution? We now plate the chain in 14-inch hanks in a cold solution, the smaller type in lengths of 150 ft weighing 6 oz, the largest chain in lengths of 25 ft weighing 11 1/4 lb. We would like to change to a larger tank and plate in 20 inch hanks. Will bright nickel plate from hot solutions take rhodium?

A. Plating a light chain at high current densities requires establishment of good electrical contact between the chain links by weighting each hank with a steel weight, insulated to prevent it from becoming plated, or with spring contact arrangement for each hank. Heavier chain may furnish the necessary contact pressure by its own weight. No difficulty is seen in rhodium plating on the bright nickel as long as any wetting agent is first removed by thorough rinsing.—K. G. SODERBERG.

A. Bright nickel plating to improve finish requires that the variation of current density be kept within the bright plate range of the solution, which may prove difficult. It is also necessary to avoid "shading", a condition which is likely to exist in a hank of chain, with accompanying dull areas. Trials should be made with bright nickel baths that can be operated at low current densities, i. e., at temperatures in the range 110 to 130° F.—G. B. HOGABOOM.

Q. 20. I am using a filter having stainless steel and nickel parts in contact with my bright nickel solution. Recently I have noticed corrosion on these metal parts of a type that would indicate they were at times acting as an anode. The suction and discharge of the filter are rubber hoses. How can these parts become anodic when the rubber hoses are non-conductors?

A. It is not necessary to have metallic connections between the pump and the plating solution to cause this type of corrosion. If one of the filter hoses is near the anodes and the other is near the cathodes, a potential drop will be found across the filter and at times current will flow through the plating solution contained in the hoses. To minimize or eliminate this anodic corrosion, place the ends of both filter hoses in the same electrical conditions, such as both discharge and suction behind the anodes or both near the cathodes.—B. C. CASE.

CORRESPONDENCE

Q. 11. Dr. Schaefer's comments on the effect of increased current density on throwing power have caused considerable discussion and some confusion, largely due to the fact that throwing power was not defined, nor were the methods of measuring it described.

There is a tendency to confuse "throwing power" with "covering power"; most people with any plating experience know that if they raise the tank voltage—throw on more current, as it were—then the solution will "throw better" into the recesses and they will be able to cover areas that cannot be plated at lower current densities.

Also entering in to confuse the issue is the term "bright-throwing power" frequently used locally in connection with high-speed copper and bright nickel baths. A bath with good bright-throwing power will plate bright in recesses and in shielded, low current density areas. This particular property seems to be largely dependent on the bright plating range of the particular proprietary solution, on the amount of metallic impurities in the bath (such as zinc and copper in nickel), and on the tolerance of the bath for these impurities. Obviously it is impossible to shift the bright plating range, as measured by the Hull cell, by increasing or decreasing the current density.—DEAN D. WILLIAMS, Los Angeles, Calif.

We expect to publish soon an article on the subject of "throw" which we hope will clarify further the points raised by Mr. Williams.—EDITOR.

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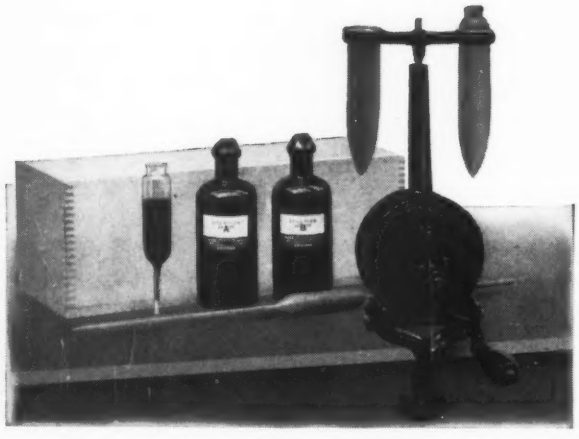

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Book Review

by DR. HAROLD J. READ,
Associate Professor of Metallurgy
The Pennsylvania State College

VOLUMETRIC ANALYSIS, VOL. II, TITRATION METHODS, by I. M. Kolthoff and V. A. Stenger, 2nd Revised Edition, 1947, xiii + 374 pages. Interscience Publishers, 215 Fourth Avenue, New York 3, N. Y. Price, $6.00.

Prof. Kolthoff's book on the principles and practice of volumetric analysis has been a classic reference work in its field, but a new edition has long been needed. In the process of revision the book has grown to three volumes, only the second of which is reviewed here, and a new collaborator has added the results of his industrial experience. Volume I deals with the theoretical aspects of volumetric analysis, and Volume III will present the practical details of oxidation-reduction methods.

The text of Volume II is divided into three major portions, the first of which describes the use and calibration of apparatus, the preparation and standardization of solutions, and the calculation of results.

The second part deals with acid-base reactions. In addition to the usual acidimetry-alkalimetry reactions, titrations involving hydrolytic precipitation and other special methods are described in detail.

Quantitative precipitation and complex-formation reactions are treated in the third part under the general headings of argentometric titrations, mercurimetry, and miscellaneous precipitation methods. This appears to be the weakest part of the book, and the omission of several precipitation procedures of considerable practical interest was noted.

In their presentation of each method, the authors have been careful to differentiate by means of subheadings and the use of different type faces the general discussion, the detailed procedure, pertinent notes relating to interfering substances, possible variations in procedure, etc. This special arrangement may be a little confusing at first to the new reader, but the regular user will find it of considerable value.

The book is definitely an advanced text and will be of comparatively little value to a tyro in analytical work. In presenting the procedures, the authors assume that the reader is capable of working out for himself the operations which will be necessary to prepare the sample for the use of the method being described. In other words, the book does not give schemes and directions for the analysis of definite substances in the so-called cookbook fashion.

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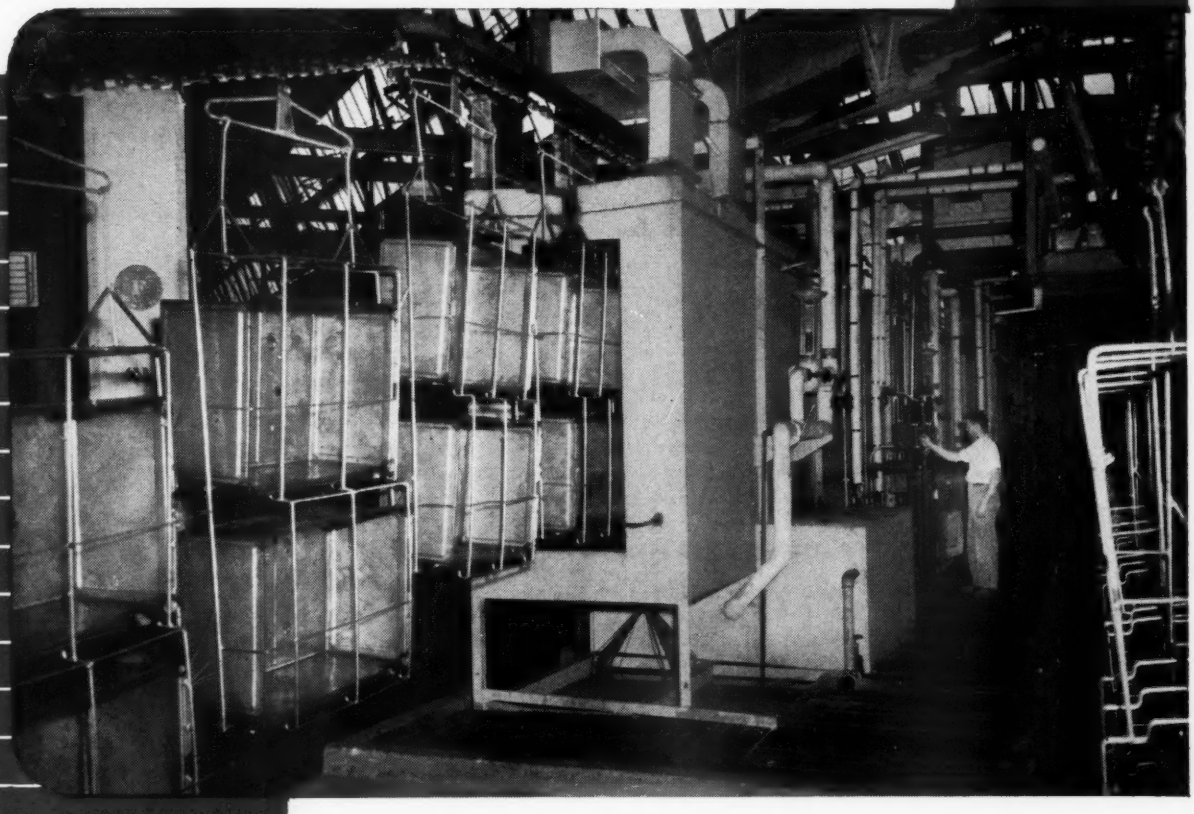

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Patents

By GEORGE B. HOGABOOM
Consultant, New Britain, Conn.

No. 2,436,316, February 17, 1948—Bright Alloy Plating—J. C. Lum and G. W. Jernstedt, assignors to Westinghouse Electric Corporation.

This invention relates to improving the electrodeposition of binary and ternary electrodeposits composed of copper and tin. In the ternary alloy, zinc is the third component.

The object of this invention is to provide for producing a brilliant silvery electroplate of an alloy containing copper and tin by applying to the electrolyte certain quaternary ammonium compounds, . . . to provide an electrolyte containing copper and tin, with or without zinc, suitable for electrodepositing an alloy therefor, and an addition agent composed of a quaternary ammonium compound to provide for a bright and homogeneous electrodeposit.

The electrolyte for producing the ternary alloy of copper, tin and zinc, consists of the following:

	oz/gal
Free cyanide	0.5 to 5.0
Copper	0.2 to 0.50
Tin	0.05 to 0.20
Zinc	0.1 to 0.5
Sodium carbonate	2.0 to 12.0
Sodium hydroxide	about 0.25 to 0.8

(to give *p*H of from about 12 to 13).

The (usual) electrolyte for barrel or still tank plating has the following composition:

	oz/gal
Copper cyanide	0.5
Zinc cyanide	0.27
Sodium stannate, $Na_2SnO_3.3H_2O$	0.22
Sodium cyanide	3.75
Sodium carbonate	4.0
Sodium hydroxide	0.6

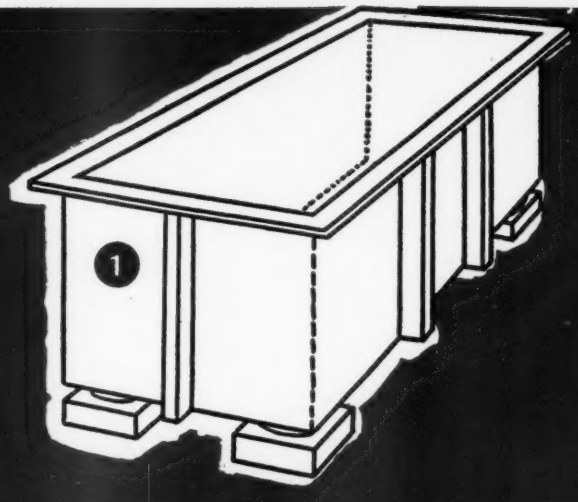
(for *p*H 12.6–13.5)

Quaternary ammonium compound, 1 g/l (5cc/gal)

Bath temperature is 140° to 160° F, tank voltage 3½ to 4½ for a current density of 20 asf. Of the total anode area, 15 to 30 per cent consist of soluble anodes containing 52 to 65 per cent copper, 25 to 35 per cent tin, and 10 to 20 per cent zinc, the remaining 70 to 85 per cent consist of insoluble anodes of steel or carbon. The resultant ternary deposit will analyze 55 to 60 per cent copper, 25 to 28 per cent tin, and 14 to 18 per cent zinc.

CLAIM 1. An alloy electroplating process which comprises electrolyzing an aqueous alkaline cyanide electrolyte containing from 0.1 to 5 oz/gal of at least one water-soluble, surface-active quaternary am-

Three Simple Steps for LOWER Tank Maintenance COSTS



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3. Clean and inspect the outside shell occasionally. The glossy Tygon surface cleans easily. If you find a scratch or break in the film caused by carelessness, touch it up with fresh Tygon Paint. The job will be as good as new.

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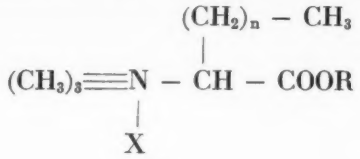
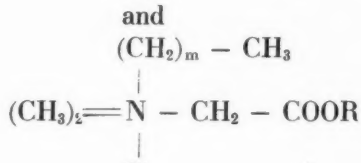
monium compound selected from the group consisting of compounds having the formulae:



and



where X represents a halogen atom, R represents an alkali metal, n is a number greater than 11 and m is a number greater than 13, the balance of the electrolyte composed of from 0.5 to 5 oz/gal free cyanide, from 0.2 to 0.5 oz/gal tin, from 0.1 to 0.5 oz/gal zinc, anions associated with copper, tin and zinc, from 2 to 12 oz/gal alkali metal carbonate and from 0.25 to 0.8 oz/gal alkali metal hydroxide, and the remainder water.

References cited: U. S. Patents Nos. 1,970,549; 2,079,842; 2,189,664; 2,198,365; 2,255,057. British Patent No. 412,477.

"Modern Electroplating", p. 77, lines 41–42 (1942); J. Am. Chem. Soc. **65,** 692–698 (April, 1943).

No. 2,436,690, February 24, 1948—Acid Chloride-Fluoride Bath for Nickel Plating—Arthur H. DuRose, assignor to Harshaw Chemical Company.

I have now discovered that the use of certain fluorides in nickel plating solutions of the high chloride type instead of the usual boric acid buffer is advantageous in respect to ductility of the resulting deposit, throwing power and freedom from pitting.

Suitable bath compositions are as follows:

	g/l
Nickel chloride hexahydrate, 33⅓ to 100% / Nickel sulfate hexahydrate, 66⅔ to 0%	200–400
A substance of the class consisting of NH_4HF_2; HF; NaF; KHF_2; NiHF and mixtures of a plurality thereof, the total fluorine content thereof being equivalent to a NH_4HF_2 content of	15–30
*p*H (may be adjusted with HCl)	2.5–5.5

EXAMPLE II

$NiCl_2.6H_2O$, g	150
$NiSO_4.6H_2O$, g	150
NH_4HF_2, g	15
Water to make, ml	1000

CLAIM 1. A nickel plating solution essentially consisting of water, from 200 to 400 grams per litre of a source of nickel of the class consisting of (1) nickel chloride, (2) nickel chloride plus nickel sulfate, in

proportion such that at least 33⅓ per cent of the nickel is from the chloride, HCl sufficient to produce a *p*H from 2.5 to 5, and a source of fluorine of the class consisting of NH_4HF_2, HF, NaF, KHF, NiF_2, NiHF and mixtures of a plurality thereof, the total fluorine content of said source of fluorine being equivalent to from 15 to 30 g/l of NH_4HF_2.

3 claims, 4 examples of solution composition.

References Cited in File: U. S. Patent No. 2,313,756; British Patent No. 513,963.

Wesley et al, Trans. Electrochem. Soc. **75**, 209–211 (1939); Thompson, Trans. Electrochem. Soc. **49**, 344-346 (1922); Blum et al, Trans. Faraday Soc. **31**, 1203–1205, 1208–1210 (1935); Field, "Electroplating", pp. 118 and 180. Circular Bur. Standards No. 100, p. 50 (1924).

No. 2,436,940, March 2, 1948—Method of Regenerating Anodizing Baths—Joseph Schulein.

CLAIM 6. A method of maintaining within an optimum operating range the *p*H value of a chromic acid bath for anodizing aluminum-base metals and which contain undissociated, soluble aluminum dichromate, which comprises withdrawing a portion of said bath when said bath attains a *p*H value of about 1.3, adjusting the *p*H value of said portion to not less than 3 with an alkaline agent of the class consisting of sodium hydroxide, potassium hydroxide, calcium hydroxide, lime and calcium carbonate to form a precipitate of aluminum hydroxide, separating said precipitate from said portion, thereafter electrolyzing said portion in a diaphragm cell to form an anolyte having a *p*H value of less than 1.3, and mixing said anolyte with the remainder of said bath.

15 claims, 2 figures.

References cited: U. S. Patents Nos. 1,857,548; 1,954,-664; 2,055,961; 2,081,787; 2,099,658; 2,159,074; 2,316,-750. British Patent No. 144,710. French Patent No. 644,077.

Mo. Rev. Am. Electroplaters' Soc. **29**, 831–837 (1942).

Hackh's "Chemical Dictionary", 2nd Ed., 1937, p. 543 ("Lime").

No. 2,437,409, March 9, 1948—Activating and Electroplating Stainless Steel—William M. Tucker, assignor to Eastman Kodak Company.

CLAIM 3. The method of activating and plating the surface of stainless steel alloys having normally a passive surface which comprises making the alloy the cathode in an electrolytic bath composed essentially of nickel chloride and hydrochloric acid, electrolyzing the bath at 100 to 300 amperes per square foot of cathode area for 2 to 4 minutes followed by a continuation of the electrolyzing at 15 to 50 amperes per square foot for 15 to 30 minutes, whereby an active surface is established on the alloy, and then increasing the plate thickness in a second plating bath before the

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2—5000/2500 AMPERE, 6/12 VOLT, **A. P. MUNNING COMPANY** "OPTIMUS" Design. Separately Excited.
1—4000/2000 AMPERE, 12/24 VOLT, **CHARLES F. L'HOMMEDIEU** "RELIANCE" Unit. Synchronous Motor Drive.
1—4000/2000 AMPERE, 9/18 VOLT, **GENERAL ELECTRIC CO.** Unit. Synchronous Motor Drive.
1—4000/2000 AMPERE, 6/12 VOLT, **HANSON & VAN WINKLE COMPANY** Compound Wound, Separately Excited.
1—1500/750 AMPERE, 6/12 VOLT, **COLUMBIA ELECTRIC COMPANY,** Shunt Wound, Separately Excited.
1—1000/500 AMPERE, 6/12 VOLT, **ELECTRIC PRODUCTS COMPANY,** Separately Excited, Ball-bearing Design.
1—750 AMPERE, 9 VOLT, **HANSON-VAN WINKLE-MUNNING COMPANY,** Interpole Construction, Latest Design.
4—1000/500 AMPERE, 6/12 VOLT, **CHARLES J. BOGUE ELECTRIC CO.** Separately Excited, Interpole Design.
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1—1000 AMPERE, 40 VOLT, **CHANDEYSSON,** Anodizing Synch. M. G. Set, Automatic Controls.
1—1000 AMPERE, 25 VOLT, **HANSON-VAN WINKLE-MUNNING COMPANY,** Separately Excited, Anodizing Unit.
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7—**G. E.** COPPER OXIDE RECTIFIERS, 500 AMPERE, 6 VOLT, for operation on 220/3/60.
12—400 AMPERE, 6 VOLT, **UDYLITE MALLORY** RECTIFIERS, with built-in Regulator.
3—1440/720 AMPERE, 6/12 VOLT, **UDYLITE MALLORY** RECTIFIERS.

M. E. BAKER CO. 143 SIDNEY STREET CAMBRIDGE, MASS.

active surface changes to a passive surface.

5 claims.

References cited: U. S. Patents Nos. 2,069,566; 2,285,548; 2,358,995.

Trans. Am. Electrochem. Soc. **27,** 144–154 (1915).

(See also Donald Wood, "A Simple Method of Plating Nickel on Stainless Steel", Metal Ind. (N. Y.) **36,** 330 (1938). G. B. H.)

No. 2,437,474, March 9, 1948—Method of Anodic Cleaning—G. H. Orozco, assignor to Giron Products Company, Cleveland, Ohio

As an illustration of the value of electrical conductivity in the present cleaner, it was found that a prior art cleaner containing 12 oz/gal of a proprietary material produced an average current density of 35 to 45 asf at 200° F at a pressure of six volts. Using the identical cleaner tank but substituting 12 oz/gal of preferred composition (Claim 4) for the prior art material, an average anode current density of 60 to 90 asf was obtained at an identical voltage and temperature. Since commercial plating generators are made for 6, 9, and 12 volt operation, it can be seen that the optimum range of high anode current density can only be obtained for a given spacing of the electrodes with a cleaner of high conductivity.

CLAIM 4. The method of cleaning and preparing metal articles for plating, which comprises removing carbonaceous film by subjecting the article anodically to a current while immersed in an aqueous alkaline cleaning bath consisting essentially of water as a solvent and a dry solute of ingredients as follows, by weight:

	Parts
A substance selected from the group consisting of sodium acetate and potassium acetate	5–50
Sodium hydroxide	10–55
Sodium carbonate	10–40
An alkaline phosphate salt from the class consisting of tetrasodium pyrophosphate, sodium metaphosphate, potassium pyrophosphate, potassium hexametaphosphate	5–55

and said bath being substantially free from silicates and borates.

4 claims.

References cited: U. S. Patents Nos. Re. 19,719; 1,334,092; 1,954,473; 2,314,285; 2,346,562. British Patents Nos. 297,508; 436,332. German Patent No. 584,477.

Mitchell, "The Cleaning of Metals", Magnus Chemical Company, Garwood, N. J. Mitchell, Metal Cleaning and Finishing **3,** 953–958 (1931); **4,** 541–546 (1932). Rogers, Trans. Electrochem. Soc. **65,** 357–360 (1934).

Promisel, Monthly Rev. Am. Electroplaters' Soc. **22,** No. 6, 4–19 (1935). Cobbs, Soap (November 1938). Engel, Metal Finishing **42,** No. 2, 80–81, 85 (1944).

No. 2,437,612, March 9, 1948—Process for Electrolytically Zinc Plating Magnesium and Magnesium-Base Alloys—H. Osborg.

CLAIM 5. A process for providing metallic magnesium and alloys thereof containing at least 51 per cent magnesium with corrosion-resistant surface which comprises establishing an aqueous electrolyte of about 1.0 normal to zinc, about 2.1 normal to CN-radical, about 0.56 normal to CO_3-radical, about 0.18 normal to fluoride, about 1.45 normal to "free" alkali, about 2.2 normal to total alkali and containing about 7.5 grams of dextrose per liter and about 1.1 grams of gum arabic per liter, pretreating said aqueous electrolyte by electrolyzing said electrolyte using a magnesium test cathode at a current density of about 35 to about 400 asf until about 840 to about 1560 watt-hours per square foot of cathode area have passed through said aqueous electrolyte at temperatures of about 20° to about 80° C whereby a modified aqueous electrolyte is produced and said test cathode is provided with a continuous adherent coating of zinc, cooling said modified electrolyte to a temperature below 35° C, immersing degreased magnesium from which surface film has been removed in said modified electrolyte as cathode, passing an electric current through said aqueous electrolyte at a cathode current density below about 40 asf for about 3 to about 20 minutes at temperatures below 35° C and voltages exceeding 6 volts, employing an anode area of about one-fourth to about one-eighth that of the cathode to obtain zinc-coated magnesium, rinsing said zinc-coated magnesium, drying said zinc-coated magnesium and subjecting said zinc-coated magnesium to heat treatment in an inert atmosphere at temperatures of about 675° F to about 800° F for about 4 minutes to about 1 minute.

6 claims.

References cited: U. S. Patents Nos. 1,801,629; 2,075,623; 2,109,887; 2,136,629.

No. 2,437,620, March 9, 1948—Method of Coating Masses of Small Copper-Bearing Aluminum Articles—W. F. Speer, assignor to Aluminum Company of America.

CLAIM. The method of oxide coating a compact mass of small copper-bearing aluminum articles which comprises making said mass of articles the anode in an aqueous electrolyte consisting essentially of about 10 to 25 per cent by weight of sulfuric acid and about 0.2 to 1 per cent by weight of chromium trioxide and having a fraction of 1 per cent by weight of copper introduced therein from the articles treated, said chromium trioxide preventing the deposition of copper-containing material on the surfaces of articles that are out of electrical contact as anode during the anodic treatment.

1 claim.

References cited: British Patent No. 290,901. Aviation 1927, 1288.

No. 2,437,865, March 16, 1948—Method of Electrodepositing Copper and Baths and Composition Therefor—J. E. Stareck, assignor to United Chromium, Inc.

The baths herein described are stable at temperatures up to the boiling point of the solution. No poisonous fumes are evolved. The operating current efficiency is nearly 100 per cent. The throwing power of the baths is excellent. Under ordinary operating conditions, temperatures from 120° to 150° F are usually preferred. For a "strike" solution, temperatures of ablout 70° to 80° F are preferred.

Agitation of the solution is desirable . . . agitation of the solution increases the operable current density range.

Composition for ordinary tank plating

	Preferred	*Optimum range*
Cu, g/l	30	24 to 36
P_2O_7, g/l	200	150–250
Citrate, g/l	15	5–25
NO_3, g/l	10	5–20
*p*H	7.2	6.8–7.5
Temperature, ° F	135	120–150

A specific example—per cent by weight:

	Per Cent
Copper pyrophosphate	19.8
Potassium pyrophosphate	72.2
Citric acid	3.7
Potassium nitrate	4.3

CLAIM 1. A composition of matter for making up a copper plating bath consisting of a soluble bivalent copper compound, a soluble pyrophosphate compound, and a soluble nitrate compound, in intimate admixture, the composition consisting, by weight, of 7.5 to 4.5 parts bivalent copper; 100 to 250 parts pyrophosphate (P_2O_7); and 5 to 20 parts nitrate (NO_3).

CLAIM 2. A composition of matter for making up a copper plating bath according to Claim 1, further containing radicals of organic hydroxy acids of the group consisting of citric acid, lactic acid, tartaric acid, glycolic acid, malic acid, capable of forming alkaline heavy metal complexes, equivalent to 5 to 25 parts citrate ($C_6H_5O_7$).

7 claims.

Reference cited: Bureau of Standards Circular No. 52, 2nd Ed., June 28, 1916, p. 19.

Mechanical Properties

(*Continued from page 455*)

tility if plated at a *p*H of 4 to 4.5, and a minimum hardness and tensile strength at the same value. The greatest elongation of annealed deposits, 56 per cent, was observed in nickel from the low chloride bath at *p*H 4.

ACKNOWLEDGMENT

The author wishes to acknowledge the advice and criticism of Dr. W. A. Wesley of The International Nickel Company, Research Laboratory.

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[2]Tucker, ibid. **29**, 196 (1942).
[3]Blum and Kasper, Trans. Faraday Soc. **31**, 1203 (1935).
[4]Ref. 1, Figs. 2 and 3.
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[6]Sorbuneva, ibid.
[7]Makar'eva, Met. Abst. **11**, 84 (1944).
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[10]Wernick, Trans. Electrochem. Soc. **62**, 27 (1932).
[11]Ref. 1, Figs. 8a and 8b.
[12]O'Sullivan, Trans. Faraday Soc. **26**, 89 (1930); Macnaughton, Gardam and Hammond, ibid. **29**, 729 (1933).
[13]Graham, Heiman and Read, Proc. Am. Electroplaters' Soc. **27**, 95 (1939).

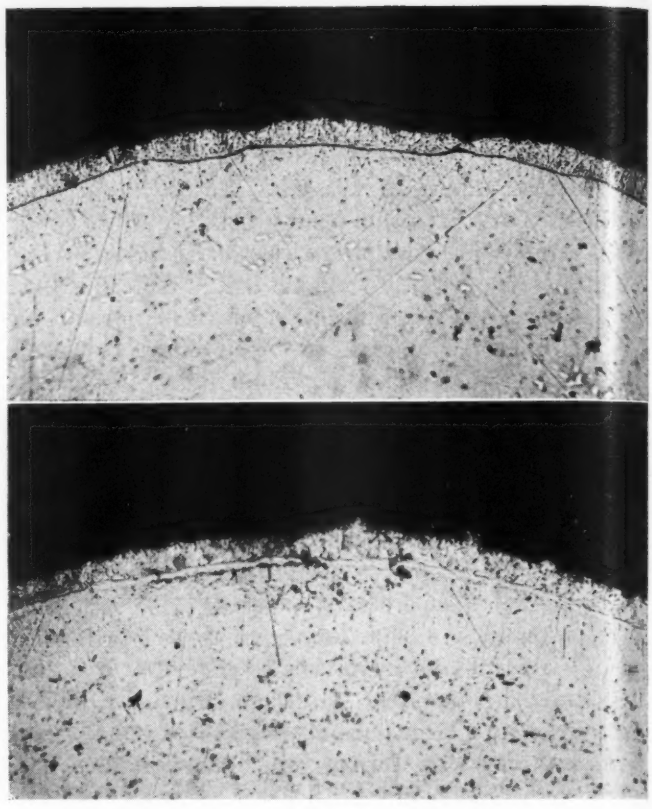

Fig. 8. Nickel plated steel at sharp bend. Top: as-plated; bottom: annealed. 250X

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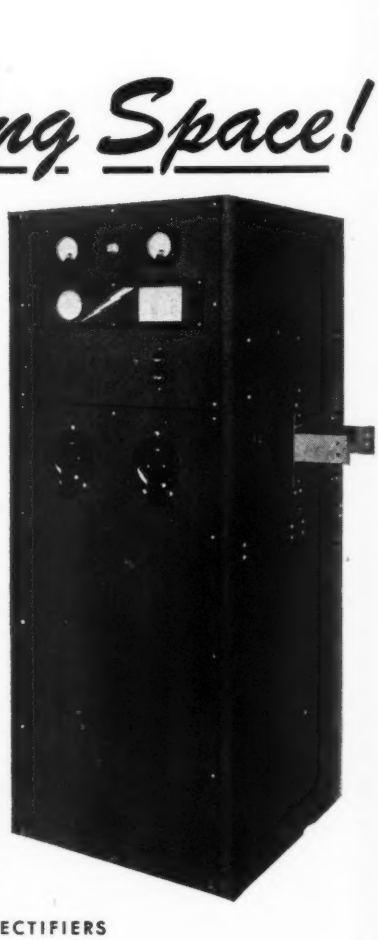

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Equipment & Supplies

E—63. Rote-Finish Machine.—A new one-compartment model has been added to the line of deburring equipment produced by The Sturgis Products Company, Sturgis, Mich. It is designed for small mechanized deburring and finishing installations but is of the same sturdy design and has the same operational features as the larger models. It is said to permit efficient and economical processing of small parts by roto-finish grinding, deburring, britehoning or coloring processes. The one-compartment cylinder (19 x 32 inches O.D.) is lined with replaceable kiln-dried hardwood maple and equipped with a full size, light weight door with newly designed molded-rubber gasket, firmly held in place by rugged fast-action cam locks. Standard equipment includes a forward and reversing switch with synchronized magnetic brake to facilitate loading and unloading; water attachment, including a conveniently located valve for adding water to the processing compartment; a 1½ hp 220-440 volt, 60-cycle, 3-phase motor with gear reducer; and a swivel type, 3-point suspension hoist pan of original and efficient design for loading and unloading of the processing media. For further information, use Reader Service Card.

E—64. Tank Magnets.—The M. E. Baker Company, 143 Sidney Street, Cambridge 39, Mass., offers a series of Permanent Alnico Tank Magnets for retrieving ferrous objects that may have dropped into plating, rinsing, pickling or other tanks, as follows: Model TM 40 having a lifting power of 40 pounds on a flat steel surface; Model TMH 40, same with 42-inch rubber covered handle; Model TM 100 with 100 pounds strength; Model TMH 100, same with 42-inch rubber covered handle. For further information, use Reader Service Card.

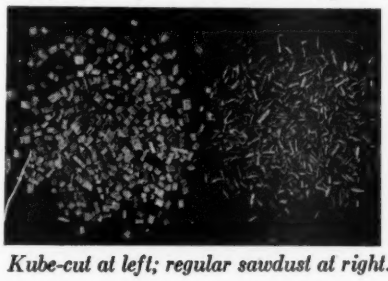
E—65. Pilot Racks—The Artisan Company, 207 Division Avenue, Brooklyn 11, N. Y., offers to serve companies which have their own rack manufacturing facilities by making single pilot racks for a maximum of loading. The racks are said to be of planned simplicity so as to be easily duplicated. For further information, use Reader Service Card.

E—66. Transparent, Protective Coating for Aluminum—The "Anonizing" Process furnished by Colonial Alloys Company, Tech. Proc. Div., Ridge Avenue and Crawford Street, Philadelphia 29, Pa., is a simple immersion method of protecting aluminum surfaces and yet maintaining natural color. Aluminum that has been etched, mechanically, electrolytically, or chemically polished as well as "as-furnished by the mill" can be treated without noticeable change in appearance. The coatings resemble an anodized coat, and are said to have good abrasion resistance, to be resistant to smudging, oxidizing, finger-marks, ordinary handling, and high temperatures, and to form an excellent base for paints and lacquers.

E—67. Corrosion Resistant Finish—Suited to stand up under the wear and tear in foundries and metal plants where acids and fumes attack wall and floor finishes is a new long-wearing synthetic paint that protects concrete surfaces with a corrosion-resisting finish that does not check, chip or pool. Introduced by Lowebco, Inc. of Chicago, the new paint is being marketed under the trade name of "Oncreto for Concrete".

Born of wartime research in the synthetics field, the free-spreading paint is said to dry to a hard, durable glossy finish in three to four hours. It seals concrete surfaces from moisture above or below. It expands and contracts easily with the material covered and resists acids, alkalis and extreme degrees of heat or cold. Besides forming a protective covering on concrete, the new synthetic paint can also be applied to exposed metals, machinery, boilers and pipes and to porous masonry surfaces.

E—68. Special Sawdust for Drying and Polishing—Michael Wood Products, Inc., 625 Midland Avenue, Dept. P, Garfield, N. J., offers a newly developed "Kube-Kut" sawdust intended primarily for drying and polishing of metals, plastics

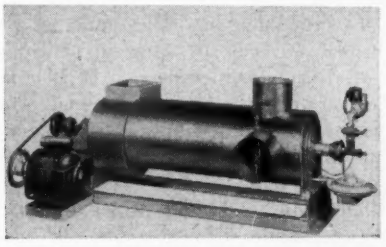


Kube-cut at left; regular sawdust at right.

and other materials, with all of the advantages commonly recognized in ordinary types of wood flour, plus the added advantages of being easily shaken free from products, not readily pulverized in tumbling processes, and creating no films on the surface of the materials, it is claimed.

"Kube-Kut" (this term is a copyrighted expression characteristic of cube-cut wood flour intended for drying and polishing purposes) is specially made from green maple sawdust at logging operations, properly screen-sifted to insure uniformity in particle size and to eliminate bark, dried in a uniformly heated rotary dryer, and again screened to obviate fine particles. For further information use Reader Service Card.

E—69. Gas Heated Air Heater—The Midget Utility Air Heater with improved design features is now available as a complete package unit, according to Gas Appliance Service, Incorporated, 1210 Webster Avenue, Chicago 14, Ill. In addition to the heater, it was stated, the "package" includes fan, motor, drive, safety devices and temperature controller.



Direct fired for maximum efficiency, it is said to be ideal for heating drying rooms and small industrial ovens. The applications include baking lacquers and enamels on metal ware. With a heating capacity of 125,000 B.T.U. per hour, the heater is suitable for temperatures up to 350° F. The fan capacity is 1000 cfm of air. For further information, use Reader Service Card.

E—70. Safety Goggles—"Safe-T-Vis", a new type of safety goggle, is being marketed by the Univis Lens Company, Dayton 1, Ohio, manufacturers of bifocal and trifocal lenses for ophthalmic use. This product is the result of many years of research to find a material that would incorporate the lightness, comfort and added safety features of plastic but would resist surface scratchings. It is made of an allyl casting resin meeting all these requirements and providing many times the surface hardness of any other plastic used for eye protection. The fact that one Safe-T-Vis lens is approximately one-half the weight of a case-hardened glass lens permits workers to wear them without discomfort throughout the period of exposure.

Safe-T-Vis lenses are available in four goggle styles and in a selection of sizes. For further information, use Reader Service Card.

E—71. Cleaner-Deodorizer—A new chemical material possessing the dual ability to clean and deodorize in a single operation has recently been announced by Oakite Products, Inc., 22 Thames Street, New York 6, N. Y. Known as Oakite Di-Sanite, it is a fine, free-flowing, mildly alkaline powder which is readily soluble in hot or cold water and is said to possess pronounced wetting, penetrating and detergent ability. The material is safe to

use, being free from abrasives and harmful ingredients, and its solutions may easily be applied on surfaces by simple sponging, wiping or mopping, the manufacturer states. It is said to be highly effective in destroying objectionable odors at the source in factories, metal plants, institutions, etc., and for deodorizing toilets, shower stalls, wash and locker rooms. For further information, use Reader Service Card.

E—72. Low-Temperature Radiation Pyrometer—Development of a revolutionary instrument which makes possible accurate and close control of low-temperature processing has been announced by Brown Division of Minneapolis-Honeywell Regulator Company. It is a low-temperature radiation pyrometer which has been tested in rubber and plastic mills and in continuous curing ovens and paint pigment kilns. The new low-range Radiamatic will find wide use where direct contact of instruments with materials is undesirable. For further information, use Reader Service Card.

E—73. Improved Print Wheel for Multi-Recording—An improved skip-numeral print wheel which, when used with strip chart electronic recorders, permits symmetrical and well-defined multiple measurement records, has been developed by the Brown Instrument division of Minneapolis-Honeywell Regulator Company. The use of lower chart speeds permits a substantial chart economy while maintaining greater clarity and permanency of recorded measurements, particularly when used in conjunction with standard charts made for the electronic recorders.

E—74. Nylon Anode and Filter Bags—Anode Products Company, 2559 N. Monitor Avenue, Chicago, Ill., offers anode and filter bags made of specially woven and washed nylon cloths, said not to contaminate plating solutions, to have as low electrical resistance as cloth anode bags. not to absorb brighteners, and to retain fine carbon particles. High resistance to solution attack and to wear are among the important properties claimed. For further information, use Reader Service Card.

E—75. New Fluorine Products—The Pennsylvania Salt Manufacturing Company, pioneer in putting fluorine on the market commercially, has announced that with expanded production facilities of the element, the company is making available several important new fluorine products. Included in these products are sulfur hexafluoride, several metal polyfluorides including cobalt trifluoride, mercury and silver difluorides and, in small quantities, certain organic fluorides.

E—76. Improved Polishing Lathes—The Hanson-Van Winkle-Munning Company, Matawan, N. J., announces that its Type MI and Type MS polishing lathes, in 3, 5, and 7½ HP sizes, can now be supplied with variable speed arrangement.

Conveniently located handwheel permits the user to obtain any speed between 1800 and 3600 rpm. The spindle speed is governed by a variable pitch motor pulley and a single, wide V-type belt. The calibrated control moves the motor and pulley assembly which changes drives centers, with the belt tension automatically maintained. The lathe is ruggedly built into a strong, welded steel base. Spindles turn in pressure-lubricated self-aligning ball bearings. The start-stop push button is within easy reach, while the magnetic starter is out of the way. Lubrication of the pulley is easy. The motor is N. E. M. A. Standard, ball bearing, open squirrel cage, enclosed and protected by the steel base. Louvre doors afford easy access to the motor and provide adequate ventilation. For further information, use Reader Service Card.

E—77. Protective Film—Indubond No. 82 is a temperature sensitive liquid manufactured by Industrial Lining Engineers, Inc., Sewickley, Pa., which, when applied to metal surfaces and heated, sets to form a new type of protective film of controllable thickness, 2 to 10 mils. The film is strippable and used for protection during shipping and storage and in metal forming operations. It contains a rust inhibitor and is said to be highly resistant to sunlight, heat, moisture, oils, acids and alkalies.

After application by spraying, brushing, dipping or roller coating, infrared drying for 90 to 120 seconds, and water spraying for cooling, it is ready for handling. For further information, use Reader Service Card.

E—78. Barrel Finishing Compounds—Sprodamine "S" is a light colored powder, said to be readily soluble in cold water and to possess powerful cleansing, emulsifying and wetting out properties, for use in the barrel finishing of all ferrous and non-ferrous metals. It is a combination of selected fats, wetting agents and alkalies. Because its *p*H is slightly above neutral, it will not cause corrosion or pitting of burnished material. Sprodamine "S" is claimed to reduce the time required for barrel finishing with conventional burnishing soaps. Since finished metal articles are free from lime-soap film, one dip in cold water should suffice to prepare the pieces for subsequent operations. For further information, use Reader Service Card.

E—79. Selenium Rectifier—A new 750-ampere, 12-volt selenium rectifier introduced by Bart-Messing Corporation 45 Morgan Avenue, Brooklyn 6, N. Y., is designed specifically for barrel plating in zinc, cadmium, nickel and copper. It is equipped with a tap switch for voltage control from 9 to 12 volts to provide economical adjustment within necessary

limits of barrel plating and is capable of operating one or more barrels depending on the size and load.

The full load operating efficiency is 77 per cent. The unit features a specially engineered heat-proof transformer which is conservatively rated and designed to withstand high temperatures and corrosive atmosphere. Some of the safety factors incorporated are positive overload protection in dc bus circuits, magnetic contactor which disconnects the unit to protect the power line in case of a short in the tanks, and positive protection against ventilation restriction. For further information, use Reader Service Card.

E—80. Small Solvent Cleaning Machine—The Klene-Ezy Parts Cleaning Machine has been recently introduced for use in metal-working plants and in garages and repair shops by Cincinnati Cleaning and Finishing Machinery Company, Ironton, Ohio. The swirling, turbulent solvent is claimed to be properly regulated by a scientifically engineered agitating mechanism and is said to assure fast and thorough removal of grease, oil, sludge, carbon or other deposits.

Sturdily built, with hinged cover and specially tempered heavy steel shell, the 54 x 21 x 32 inch high unit may be installed near any electric outlet. It can be used for hot or cold washing and has convenient drains for muck removal, and provision for reclaiming solution used. The solvent chamber is 30 gallons capacity. For further information, use Reader Service Card.

New Literature

L—41. Automatic Boiler.—A 4-page Bulletin 148 desciiber the Alere "Hot Steam" Automatic Boilers manufactured by Alert Engineering Products Company, 305 W. Woodbridge Street, Detroit 26, Mich. A package unit with oil or gas burner, it is available in sizes of 2 to 50 hp with steam pressure of 100 psi or higher if desired. For your copy, use Reader Service Card.

L—42. Carbide Tool Grinder.—A 12-page catalogue entitled, "Carbide Tool Grinder Catalogue No. 220", illustrates and describes on the extensive and complete line of wet and dry carbide tool grinders, chip breaker tool grinders and diamond finishing tool grinders manufactured by Hammond Machinery Builders, Inc., Dept. GP-10, Kalamazoo 54, Mich. For your copy, use Reader Service Card.

L—43. Safety for the Household.—The principal hazards to safety in the home, and the means for eliminating or reducing them, are discussed in detail in the new, 200-page edition of "Safety for the Household", now available at 75 cents a copy from the Superintendent of Documents, Washington 25, D. C., as National Bureau of Standards Circular 463. While written mainly for the average present-day household, this booklet provides information that is also of value in the construction and safe operation of warehouses and industrial plants. Chapters on gas, building construction, refrigerants, fire prevention, heating equipment, plumbing, fire extinguishers, electrical equipment, and other special items have been prepared by qualified specialists from the various sections of the Bureau.

L—44. 3M Adhesives in Industry.—Research help for industrial customers in choosing the right adhesives, sealers, and coatings is offered in a new 28-page brochure by Minnesota Mining and Manufacturing Company, 901 Fauquier Avenue, St. Paul 6, Minn. It cites 18 case histories, and lists 26 of the more than 1,000 formulae offered by the company's adhesives and coatings division in Detroit. For your copy, use Reader Service Card.

L—45. Zinc Anodes—A new folder, die cut in the distinctive shape of their recently introduced Flat Top anode, has been released by Wagner Brothers, Inc., Dept. K, 425 Midland Avenue, Detroit 3, Mich. The two-color four-page folder describes six advantages of the new zinc anode, principally the shape which eliminates possible confusion of zinc with cadmium or tin anodes. Space has been provided for imprinting with names of qualified metal-finishing supply houses, as nationwide distribution is planned. For your copy, use Reader Service Card.

L—46. Commutator Brushes—"Keystone Precision Molded Products for the Electrical Industry" is the title of a folder published by Keystone Carbon Company, 1935 State Street, Saint Marys, Pa. It describes Keystone powder metal parts and "Selflube" bearings, Keystone slip ring and commutator brushes, and Keystone negative temperature coefficient resistance units. For your copy, use Reader Service Card.

L—47. Emulsion Cleaners—The Du Bois Company, Cincinnati 3, Ohio, announces the release of a new four-page booklet listing the various Petroleum, Aromatic and Chlorinated Hydrocarbon solvents commonly used in metal cleaning. Tabulated data on flash points, boiling ranges, chemical constitution, toxicity and other important factors make possible easy selection of the correct solvent best suited for a particular job.

This booklet discusses the use of emulsion cleaning and the effect of the various solvent groups on particular soils. Flash points are given for each of these solvents mixed with Actusol, an emulsifiable oil detergent manufactured by the Du Bois Company which raises the flash of combustible solvents and provides protection for the skin. It is used to augment the solvent power, emulsify insoluble soils, and provide water rinsability in solvent cleaning operations.

L—48. Instruments and Controls—A new 68-page catalogue No. 48 has been

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issued by Electro-Tech Equipment Company, 117 Lafayette Street, New York 13, N. Y. It describes and lists prices of all types of laboratory and portable test instruments, service instruments, pyrometers, transformers, rectifiers, regulators and miscellaneous equipment. For your copy, use Reader Service Card.

L—49. Strainers—Folder No. 115 issued by Hays Manufacturing Company, Erie, Pa., describes and illustrates in color "Straitflo" strainers for use on water, steam, oil, air, and gas supply lines. Instructions for strainer cleaning are included. For your copy, use Reader Service Card.

L—50. Glass Electrode Errors—"RP1848, Voltage Anomalies of the Glass Electrode and the Chemical Durability of the Glass" by Donald Hubbard and Gerald F. Rynders is a recent 10-page publication from the National Bureau of Standards which may be obtained from the Superintendent of Documents, Washington 25, D.C., at 10 cents. It includes additional work on the relation between voltage errors of electrodes prepared from Corning 015 glass and the change in durability of the glass, and confirms and extends previous findings.

L—51. Maintenance Painting Costs—A new, simplified method of making comparative cost studies of painting maintenance by conventional and Prufcoat methods is now possible with the Protecto-Graph Plan, a development of Prufcoat Laboratories, Inc., 63 Main Street, Cambridge, Mass. Upon request, Prufcoat Laboratories will send a Protecto-Graph Analysis Sheet plus a sample of a typical Prufcoat Protecto-Graph. When received, the user simply fills out and returns the Analysis Sheet. Working from this information, Prufcoat Engineers will then plot a graph showing the cost of painting by present method compared with cost of doing the same job with Prufcoat. Long-term painting maintenance savings of 50, 60, and even 70 per cent are said to be possible when Prufcoat coatings are used to protect against corrosion caused by acids, alkalis, alcohol, oil or water. For your copy, use Reader Service Card.

L—52. Plating Barrels of Lucite—Ribless plating barrels of transparent Lucite are now being manufactured by Hardwood Line Company, 340–342 N. Artesian Avenue, Chicago 12, Ill. Its "Plating Barrel" 4-page bulletin shows two portable units with 6 x 12 and 8 x 18 inch cylinders and individually motor driven single (including hand-hoist operated) and multiple units with 14 x 30, 14 x 36 and 14 x 42 inch cylinders. Some of the advantages claimed are inertness to cleaning and plating solutions, light weight and absence of treeing on continued use. For your copy, use Reader Service Card.

L—53. Aluminum Sheet and Plate—One of the most complete helps in its field is the Aluminum Sheet and Plate Booklet just released by the Reynolds Metals Company, Louisville 1, Ky. It covers 48 pages of technical information relative to various sheet and plate alloys, gauges and sizes.

Beginning with a brief discussion of cost factors, the booklet goes into a careful comparative analysis of costs of aluminum sheet and plate as against other widely used metals and proceeds into short summaries of such topics as formability, weldability, riveting and joining, brazing, soldering, machinability, and resistance to chemical attack with a short discussion of the alloys most suitable. Also given is a short explanation of heat-treatable and non-heat-treatable alloys.

Finishes for aluminum sheet and plate, characteristics of the metal, and the problem of avoiding distortion are likewise summarized briefly, and a number of special items not previously shown in regular literature or information are listed in the booklet. For your copy, use Reader Service Card.

L—54. Motor Generator Equipment—A 4-page bulletin picturing and reviewing its line of motor generators has been published by Motor Generator Corporation, Troy O. The units are designed for various applications and range in size from ½ to 20 kw. Metal plating equipment is available in sizes ranging from 5 to 20 kw. Additional equipment includes units for metal coloring and finishing, materials handling, and electroplating as well as buffers and grinders. For your copy, use Reader Service Card.

L—55. Infra-red Heating—"Modern Baking, Drying, Heating with Industrial Infra-red Lamps" is a new 16-page booklet A-3817 announced by Advertising and Sales, Westinghouse Lamp Division, Bloomfield, N. J.

Case histories are given to show how infra-red cuts costs, speeds production and saves space wherever heat is required for finish baking or mass heating. A check list of applications for which it is now being used names more than seventy operations and processes in a wide variety of industrial plants. Four major types of installations are discussed—the portable or non-oven type, the single-walled oven, the double-walled oven, and the insulated oven. Application data to aid in planning installations is included. For your copy, use Reader Service Card.

L—56. Proceedings of Materials Handling Conference—"Some Basic Techniques in Materials Handling" is the title of a report of the proceedings at technical sessions of the Conference on Materials Handling held in Cleveland last January. The book is believed to be the first report of its nature ever published and one of the few texts on materials handling problems. Nineteen papers are included. The book contains 84 pages, 8½ x 11 inches, is paper covered and includes 15 pictures, 11 diagrams, and four charts and tables. It may be obtained for $1.00 from Clapp & Poliak, Inc., 350 Fifth Avenue, New York 1, N. Y.

L—57. Sheepskin Disks and Wheels—A new illustrated 2-page bulletin covering sheepskin discs and wheels has just been issued by Divine Brothers Company, 200 Seward Avenue, Utica 1, N. Y. This bulletin gives valuable specification data, recommended uses, and the various forms available for polishers' use. The different qualities of sheepskin are also discussed. For your copy, use Reader Service Card.

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Abstracts

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Zinc Alloy Die Castings—Quality, Design and Plating Procedures. L. A. J. Lodder. J. Electrodepos. Tech. Soc. **22,** 199–205 (1947).

Elemental principles of die casting, inspection, and design of die castings for plating are discussed. Usual English methods of preparation for plating are reviewed; electrocleaning is generally cathodic and for a short period (not over 30 seconds). Adequate thickness of copper prior to nickel plating is emphasized. A cyanide copper bath containing sodium carbonate, as recommended by Wernick, is favored because of better brightness of the subsequently applied nickel deposit. In deprecating "the somewhat misleading use, mainly in America, of the word 'strike' to describe the primary copper deposit on zinc alloy die castings," because "the use of the word implies a very thin coating and is liable to misinterpretation in this case", it may be that the author does not understand that the copper "strike" applied in America is just that and is almost always followed by a deposit of 0.0002 inch or more of copper from a proprietary bright copper bath.

LYMAN B. SPERRY.

Pre-Treatment of Zinc Die-Castings Prior to Bright-Nickel Plating. P. Berger. J. Electrodepos. Tech. Soc. **22,** 207–218 (1947).

Different operations in the preparation of zinc base die-castings for plating are discussed, some of which would be considered unorthodox in the United States. For soak cleaning, a synthetic soap and several wetting agents are recommended to be used at 160 to 190° F. For electro-cleaning, the following solution is recommended, to be used cold, with the work cathodic at 6 volts for not over 30 seconds: sodium cyanide—4 to 5 oz, sodium hydroxide—½ to 1 oz, rochelle salt—4 to 6 oz, sodium metasilicate—1 oz, and water—1 Imp. gal. Current should be on before immersion and remain on until after work has been removed. For acid dipping, it is recommended that this be either electrolytic or inhibited. Copper is preferred to brass for an undercoat. Bronze (copper-tin) is also considered.

LYMAN B. SPERRY.

A Comparison of British and Spanish Practice in the Chromium Facing of Press Dies. Juan B. Vericat Raga and Joaquin Agullo Marly. Sheet Metal Industries **24,** 1829–1835, 1839 (1947).

Two Spanish technicians make a critical analysis of "Chromium Facing Press Dies" by E. A. Ollard and E. B. Smith, which appeared in the June issue. The article and accompanying illustrations are reprinted from Tecnica Metalurgica. Also included is a detailed reply, by Ollard and Smith, to the various points raised.

Discussion of the Preceding Two Papers. J. Electrodepos. Tech. Soc. **22,** 219–226 (1947).

This covers discussions at London and Birmingham. Many phases of both papers are commented on. The undesirability of stress in the copper deposit is mentioned repeatedly.

LYMAN B. SPERRY.

Microchemical Control of Zinc Plating Baths. F. K. Gerke, Z. I. Dreval, and V. P. Zvereva. Zavodskaya Laboratoriya **12,** No. 11–12, 908–911 (1946); Henry Brutcher, Altadena, Calif. Translation No. 1972, 8 pp.

Gives results of a study of microchemical methods suitable for the above. Recommended and described in detail are nephelometric methods for zinc and lead, the effects of bath contaminants on results of the method for nitrate nitrogen described by Grandval and Liage, and a colorimetric procedure for iron.

High Production Job Shop Plating. Louis J. Donroe. Metal Finishing **45,** 71–74 (September 1947).

Describes surface preparation and plating procedures on full automatic and semi-automatic plating equipment in one of the largest job-shop plating plants in the country.

Toxicity of Chemicals in Electroplating (Continued). P. M. Van Arsdell. Metal Finishing **45,** 79–83 (September 1947).

Concludes section on chromates. Covers cobalt compounds; copper and copper salts; gold compounds; iron and the ferric salts; lead and lead salts; mercuric salts; nickel and nickel salts; rhodium; platinum; and palladium. (To be continued.)

Ferric Ion Corrosion During Acid Cleaning. F. N. Alquist, J. L. Wasco, and H. A. Robinson. Corrosion **3,** 482–487 (1947).

Describes a type of corrosion which occurs during the acid cleaning of equipment containing ferric oxide deposits—corrosion of the parent metal by ferric ions from the iron oxides as they are reduced to ferrous ions. Several ways of reducing or eliminating this type of corrosion were investigated. Major emphasis was on use of some compound which would reduce the ferric ion before it attacked the metal. Glyoxal was found most satisfactory.

Anodic Behaviour of Mild Steel in Strongly Alkaline Solutions. Charles D. Weir. Nature **160,** 259 (August 23, 1947).
Results of experiments are outlined and charted.

Survey of the Cleaning Methods Used for Iron and Steel Surfaces. Rick Mansett. American Paint Journal **31,** 54, 56, 60 (September 1, 1947).
Discusses use of solvent cleaners, steam cleaning, phosphoric acid cleaners, vapor degreasing, alkaline cleaners, and electrolytic cleaners.

Electrodeposited Oxide Layers on Aluminum. Fritz Liechti and W. D. Treadwell. Helvetica Chimica Acta **30,** No. 5, 1204–1218 (1947).
The growth and analysis of oxide films on aluminum during anodic oxidation in sulfuric and oxalic acid solutions, respectively, with and without bath agitation, were investigated. Results are charted and tabulated, and an equation is deducted from the curves for the film from the sulfuric acid bath which shows that the sulfate-ion content of the film decreases exponentially with its thickness. In oxalic acid, no appreciable solution of the film takes place.

Tin Undercoating Improves Rust Resistance of Steel. Anon. Iron Age **160,** 45 (October 23, 1947).
Use of an 0.00005 inch thick coating on mild steel before painting is recommended. (From report of Tin Research Institute.)

Plating Molybdenum, Tungsten, and Chromium by Thermal Decomposition of Their Carbonyls. J. J. Lander and L. H. Germer. Metals Technology **14,** T. P. 2259 (September 1947).
Describes the plating of molybdenum and tungsten, and of compounds and alloys of these metals, by pyrolysis of their carbonyl vapors. Chromium has also been plated in this manner, but the results have been much less satisfactory. The apparatus, procedures and properties of the products are described in detail. Also described are the plating of magnetron rings for test purposes and the design of a machine for conducting this operation on a commercial basis. 15 ref.

Protection of Iron and Steel by Metallic Coatings. J. C. Hudson and T. A. Banfield. Iron and Steel Institute, London. Advance copy. (December 1946.) 36 pp.
Describes observations on the behavior of a wide range of protective coatings applied to mild steel exposed to field corrosion tests as part of the investigations of the Protective Coatings Sub-Committee. These results cover periods of up to five years of atmospheric exposure and two years of immersion in sea water. The coatings investigated were aluminum, cadmium, lead, tin, and zinc, also 82/18 cadmium-zinc alloy and 88/12 lead-zinc alloy. They were applied in one or more of three standard thicknesses by a wide variety of processes including cementation, electrodeposition, hot-dipping, and spraying. Sprayed specimens were prepared by three types of metal-spraying process, namely, the molten-metal pistol, the powder pistol, and the wire pistol. 18 references.

Fluid Mechanics: Forgotten Factor in Electroplating. Joseph B. Kushner. Metal Finishing **45,** 72–74 (October 1947).
Points out importance of fluid mechanics to the electroplater, describes fundamental principles, and indicates necessity for research along these lines.

Toxicity of Chemicals in Electroplating (Concluded). P. M. Van Arsdell. Metal Finishing **45,** 75–81 (October 1947).
Covers silver and its salts; tin and its salts; zinc and its salts; acids; alkalies, cyanides; sulfides; sulfates; oxalic acid; hydrogen fluoride; the fluosilicates and fluoborates; and neutral solutions. Includes table of toxic reactions and first-aid procedures.

Anodes—III. Cast and Rolled 70/30 and 80/20 Brass. IV. Operating Factors Involved in the Utilization of Gold. V. Zinc, Cadmium, Tin, Lead. E. R. Thews. Metal Industry **71,** 225–226, 268–269, 307–309 (1947).
In Part III mention is being made of the physical state of brass anodes, the effect of zinc content, and methods of fault determination. In Part IV the utilization of gold anodes for practical plating purposes is discussed. Part V discusses the elimination of the excessive solubility of pure zinc anodes and the effect of alloying additions to cadmium anodes. Tin and lead anodes are also mentioned briefly.

A Comparison of Infra-red and Convection Oven Baking. American Paint Journal **32,** 24–30 (November 10, 1947).
Results involving some 350 duplicate tests made on baked finishes, differing only in baking, indicate that in the case of the six type-formulations tested, infra-red and convection-oven baking produced equivalent film properties when all variables except the source of heat energy were held constant. No appreciable photochemical or catalytic effect differing from that obtained in the convection oven was observed as a result of the use of infra-red.

The Influence of Hard Chromium Plating on the Fatigue Strength of Aluminum Alloys. Ernst Raub. Metallforschung **2,** 121–126 (April 1947).
The fatigue strength of pressed bars of aluminum-magnesium and aluminum-magnesium-zinc alloys, as affected by different surface treatments (including hard chromium plating) was investigated. The influence of various thicknesses of chromium and of crystal structure on fatigue strength was also determined.

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New Proposed A.E.S. Constitution

The following proposed Constitution for the American Electroplaters' Society has been prepared by the Constitution Revision Committee composed of A. W. Logozzo, Hartford Branch, Chairman; F. J. MacStoker, New York Branch; F. R. Keller, Pittsburgh Branch; C. F. Nixon, Detroit Branch; and C. Kelly, Chicago Branch. It incorporates the opinions expressed by the Branches through their own committees but has not yet been approved by the Law Committee as to wording and classification as stated erroneously in the April issue.

CONSTITUTION

PREAMBLE

NAME, OBJECT, AND DIVISIONS

This society shall be known as American Electroplaters' Society, Incorporated, hereinafter called the Society. It shall be incorporated under the laws of the State of New Jersey.

The object of the Society shall be the improvement and dissemination of the knowledge of the arts and sciences of electrodeposition and of finishing of metals and of allied arts, the development of a cooperative spirit of friendship and mutual assistance among its members.

The Society shall consist of members duly elected to membership under the Constitution and By-Laws. There shall be branch or local societies, hereinafter called Branches, duly organized under the Constitution and By-Laws as integral parts of the Society. The Branches shall consist of members of the Society who have become members of the Branches of their choice through the procedures established by the said Branches under the provisions of this Constitution.

There shall be a governing body called the Supreme Society, consisting of delegates duly elected by the several Branches.

There shall be an Executive Board, duly elected by the Supreme Society in accordance with the Constitution and By-Laws.

PART I. THE SOCIETY

Article I. Functions

Section 1. Organization: The Supreme Society shall consist of three Active Members in good standing from each Branch in good standing, hereinafter called Delegates, whose credentials have been duly accepted in Annual Meeting. An elected officer of the Society shall automatically be one of the three Delegates from his Branch. A quorum for the transaction of the business of the Supreme Society shall be two-thirds of the Delegates, present in person or by proxy.

The Executive Board shall consist of the President, the Past President, the First Vice-President, the Second Vice-President, and the Third Vice-President. A quorum for the transaction of the business of the Executive Board shall be four of the above-named officers.

Section 2. Authority: The Supreme Society shall be the governing body of the Society, and all Branches shall be subject to the laws by it enacted. Its decisions shall be final.

The Executive Board shall be the administrative body of the Supreme Society. It shall conduct the ordinary business of the Society under the provisions of the Constitution and By-Laws and the rulings of the Supreme Society. Its decisions shall be subject to review by the Supreme Society.

Article II. Membership

Section 1. Members: Any person interested in the object of the Society may become a member.

Section 2. Classes of Membership: The Society shall consist of Active Members, Student Members, Sustaining Members, and Honorary Members.

Section 3. Active Members: Any person interested in the object of the Society may be elected an Active Member.

Section 4. Student Members: Any person not over twenty-five years of age, regularly enrolled in full-time courses at any accredited university or other institution of learning and interested in the object of the Society may be elected a Student Member.

Section 5. Honorary Members: Honorary Membership may be conferred by majority vote of the Supreme Society in Annual Meeting upon any person whose knowledge and outstanding service have enhanced the welfare of the Society. A Branch desirous of having any person elected Honorary Member shall nominate that person, with appropriate information in support of his eligibility, to the Executive Board. If a majority of the Executive Board approve the nomination, it shall be presented for vote to the Supreme Society at the next Annual Meeting.

Section 6. Sustaining Members: Any firm or person interested in the electroplating and metal-finishing industry or in the object of the Society may be elected a Sustaining Member by majority vote of the Executive Board.

An Active Member may also be a Sustaining Member.

Section 7. Privileges: Student Members and Sustaining Members shall have all rights of membership except those of voting and holding office. Members not belonging to Branches shall have all rights of membership except holding office or election as Delegates.

Section 8. Branch Membership: Application for membership in a Branch shall be made by the candidate for admission to the Branch Secretary on the official form accompanied by the application fee. The Branch Secretary shall submit the application to the Board of Managers or other established body of the Branch, which shall investigate the references of the candidate and approve or disapprove the application by majority vote. An approved application shall at the next regular meeting of the Branch be submitted to the Branch for action. The Branch Secretary shall immediately notify the Executive Secretary of the election of any new member.

Section 9. Membership-at-Large: A candidate for membership not desiring membership in any Branch may become a Member-at-Large. Application for Membership-at-Large in the Society shall be made to the Executive Secretary on the official form accompanied by the application fee. The Executive Secretary shall submit the application to the Executive Board, which shall investigate the references of the candidate and shall within thirty days of receipt of application admit or reject the candidate by majority vote.

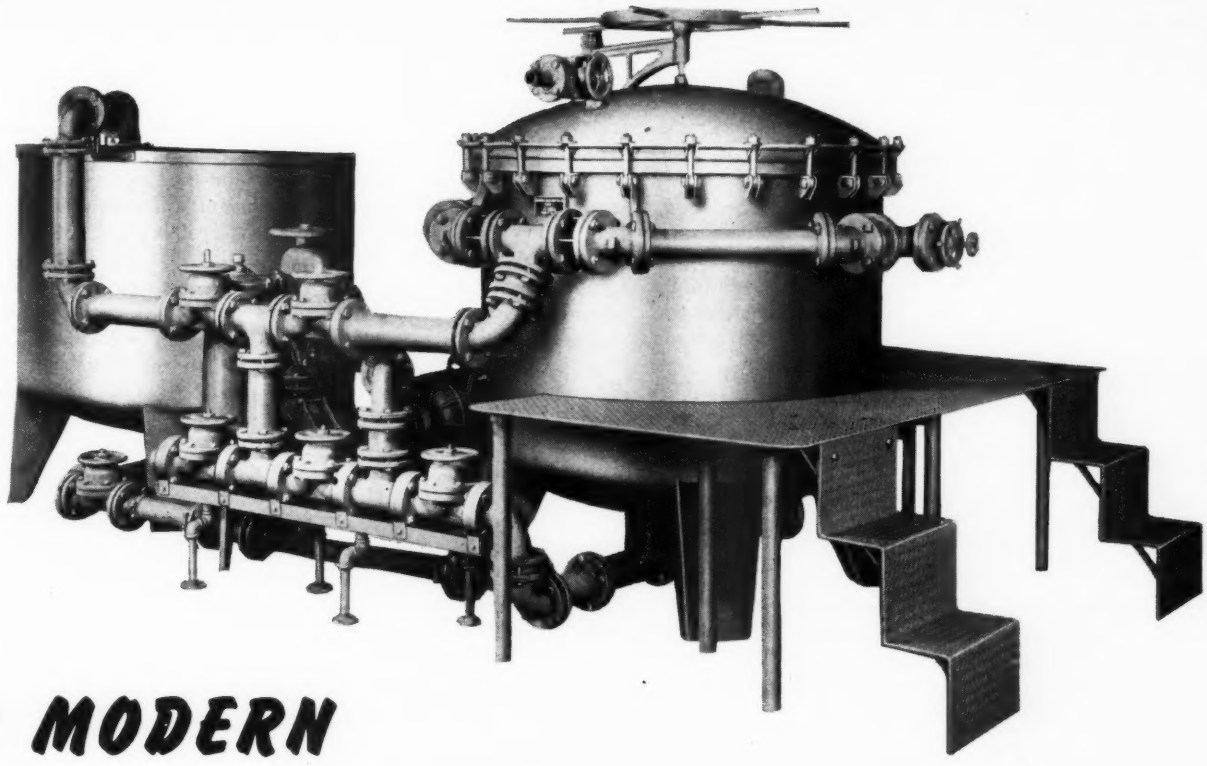
Section 10. Obligation: Each applicant for membership shall receive a copy of the Constitution and By-Laws and shall read and accept same. He shall not be permitted to plead ignorance in extenuation of any violation of their provisions.

Section 11. Transfer: A member in good standing may transfer from one Branch to another Branch, from Membership-at-Large to membership in a Branch, or from membership in a Branch to Membership-at-Large with the consent of the governing bodies involved and through such procedure of transfer as may be established by the Executive Board of the Society.

Section 12. Resignation: A member shall be permitted to resign from the Society only when his dues shall have been paid in full to date of resignation.

Section 13. Expulsion: A member having made false or misleading statements in applying for membership or having acted in violation of the Constitution may be expelled from the Society by the Branch, or in the case of a Member-at-Large by the Executive Board, and all monies received from him shall be forfeited by him. However, before acting upon any measure of expulsion, the Branch or the Executive Board, as the case may be, shall provide the alleged offender with full and due opportunity to defend himself in open hearing against the charges brought against him.

Section 14. Reinstatement: Any former member of the Society who may wish to be reinstated shall be considered a new candidate for membership. *Turn Page*



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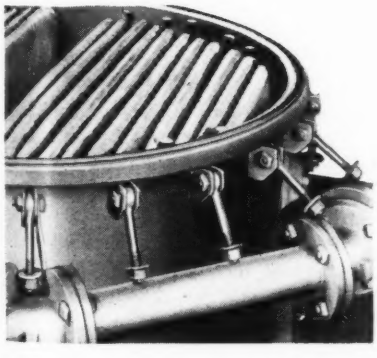

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ARTICLE III. DUTIES OF MEMBERS

Section 1. Voting: Delegates may vote in person or by proxy at the Annual Meeting of the Supreme Society. The Branch delegation of which a presiding officer is a member may replace him with an Alternate on the floor of a meeting. The presiding officer at a meeting of the Supreme Society may cast a deciding vote in case of tie.

Section 2. Proxies: A Delegate or Delegates may exercise the proxy of any Delegate elected by the Branch, and the Delegates of any Branch may represent not more than one other Branch by proxies duly presented to the Credentials Committee and accepted by the Supreme Society.

ARTICLE IV. OFFICERS

Section 1. Roster: The Officers of the Society shall be Past President, President, First Vice-President, Second Vice-President, Third Vice-President, Executive Secretary, and Residing Legal Officer. A member residing in New Jersey shall be Residing Legal Officer of the Society in the State of New Jersey. The Executive Secretary and Residing Legal Officer shall be appointed by the Executive Board, and each shall serve until his successor shall have been appointed and installed. All other Officers of the Society shall be elected.

Section 2. Qualifications: Each Officer of the Society shall be an Active Member of the Society in good standing. Each elected Officer shall further be a Delegate. The President of the Society shall before election have served at least one term on the Executive Board.

Section 3. Term: The term of an elected Officer shall be for one year or until his successor shall have been elected or appointed and installed. No person shall hold the same elective office more than two terms in succession.

Section 4. Vacancy: In the event of a vacancy in the office of President, the Vice-President highest in rank shall succeed.

Section 5. Past President: The retiring President shall become the Past President of the Society.

ARTICLE V. FINANCES

Section 1. Application Fees: The minimum application fee shall be five dollars. Application fee shall be submitted with each application for membership and paid to the Branch, or in case of application for Membership-at-Large to the Supreme Society.

Section 2. Annual Dues: (a) The minimum annual dues of Active Members shall be eight dollars. (b) The minimum annual dues of Student Members shall be five dollars. (c) The minimum annual dues of Sustaining Members shall be one hundred dollars and shall be paid to the Executive Secretary. (d) The dues of Members-at-Large shall be paid to the Executive Secretary.

Section 3. Per Capita Tax: From the annual dues of each Active, Student, and Sustaining Member there shall be paid to the Supreme Society a Per Capita Tax of four dollars and seventy cents ($4.70), part of which shall be used to pay the annual subscription to the official journal of the Society at one-half of the regular subscription price.

Section 4. Fiscal Year: The fiscal year of the Society shall commence on the first day of April. All financial reports shall be made from and all transactions closed to conform with the end of the fiscal year on the thirty-first day of March.

ARTICLE VI. MEETINGS

Section 1. Annual Meeting: The Annual Meeting for the transaction of business of the Supreme Society shall take place during the Annual Convention. The Annual Meeting and Convention shall be held between June 1 and September 30 unless otherwise agreed between the Executive Board and the Branch designated to entertain the Convention, hereinafter called the Host Branch. In national emergency the Executive Board may suspend the Annual Meeting and conduct the affairs of the Society and Supreme Society by letter ballot.

Section 2. Special Meetings: A Special Meeting shall be called by the President, with the approval of the Executive Board, upon the written application of a majority of the Branches. The purpose of such Special Meeting shall be stated in writing in the application and the Executive Secretary shall send a copy of the said statement to each Delegate. No business not included in the said statement shall be transacted at any Special Meeting, nor shall a Special Meeting be called to consider any matter that can be decided by law or by the Executive Board under this Constitution and By-Laws.

ARTICLE VII. CHARTERS

Section 1. Granting and Voiding: The Executive Board may grant Temporary or Permanent Charters to Branches duly organized under the Constitution and By-Laws. The Executive Board may at its discretion revoke any Temporary Charter. The Supreme Society may on the recommendation of the Executive Board or upon presentation of evidence revoke for cause the Permanent Charter of a Branch.

Section 2. Temporary Charters: A Temporary Charter may be granted to any group, provided that:

It shall have a membership of not less than ten persons eligible for Active Membership in the Society. Any of these persons may be members of an existing Branch.

Each applicant not already a member of the Society shall make application for Active Membership to the Executive Secretary as provided in this Constitution, and applicants already members shall submit evidence of good standing. The requisite number shall be acceptable to the Executive Board.

The applicants shall petition in writing for a Charter, and each applicant shall over his signature pledge loyal support to the Society and obedience to its Constitution and By-Laws.

Section 3. Duration of Temporary Charter: A Temporary Charter shall be in force until a Permanent Charter is granted or until it is revoked by the Executive Board. The Executive Board shall revoke any Temporary Charter if application for a Permanent Charter be not made within one year of issue of the Temporary Charter.

Section 4. Permanent Charter: The Executive Board shall grant a Permanent Charter upon written application to any Branch that has operated for three or more months under a Temporary Charter.

Section 5. Branch Franchise: Charters shall not be granted to more than one Branch in any city.

ARTICLE VIII. OFFICIAL PUBLICATIONS

Section 1. Official Journal: The Society shall publish periodically an official journal which shall contain articles pertaining to the object of the Society, changes in membership, news of the organization and its members and of the industry in general, and other matters of value to the membership. Each member of the Society in good standing shall receive a copy of the official journal for one-half the regular subscription price, paid to the Society out of his annual dues. Non-members shall be offered subscription at the regular price.

Section 2. Proceedings: Each member in good standing shall receive a copy of the technical proceedings of the Annual Convention.

Section 3. Minutes of Annual Meetings: One copy of the minutes of the Annual Meeting shall be sent to each Branch Secretary and to each elected Officer of the Society.

Section 4. Release of Papers: Papers presented before a Branch shall be the property of the authors. With the consent of the authors, a Branch may offer such papers for publication in the official journal of the Society.

PART II. BRANCHES

ARTICLE I

Section 1. Names: A Branch shall be known as ———— Branch of the American Electroplaters' Society, the blank in this name being the name of the city or locality of the Branch.

Section 2. Organization: Branches shall elect their own officers and may operate under any rules or laws of their own

(Continued on page 491)

A. E. S. News

Cavalcade of America

E. I. du Pont de Nemours & Company, in recognition of the importance of the plating industry, will make note of the Convention and the Industrial Finishing Exposition on one of its popular "Cavalcade of America" broadcasts during the month of June.

Branch Exhibits

All Branch Exhibits for the forthcoming A. E. S. Convention must be shipped express prepaid and must reach Atlantic City by June 25. Shipping address is

AMERICAN ELECTROPLATERS' SOCIETY
CONVENTION HALL
ATLANTIC CITY, N. J.
ATT.: MR. LOUIS J. DONROE

No limit has been set on space allotment. Objects may be mounted on 3 x 4 foot boards with dark background or in any convenient manner. The Newark Branch, host to the Convention, will supply tables for display of specimens. The local committee will handle all unpacking and packing and the arrangement of the Exhibits.

Eligibility for prizes, according to the Society's rules, requires that procedures used in the finishing of the specimens be exhibited with them.

Remember Delegates' Credentials

The Credentials Committee for the 1948 Convention will be comprised of the three Delegates elected by the Society's Philadelphia Branch. It will meet on or about May 15 to examine the Delegates' credentials so that they can be approved in advance of the Annual Meeting.

Each Branch should make certain that the necessary Delegate Report Sheet is in the Executive Secretary's hands prior to the deadline, May 15.

Branch News

According to the By-Laws of the American Electroplaters' Society (Part II, Article II, Section 4) the Branch secretary "shall send to the Executive Secretary a report of each meeting and a copy of all appropriate papers within seven (7) days of the date of the meeting". The proposed revision of the By-Laws (Part II, Article V, Section 4) provides that "The secretary shall keep accurate records of all meetings of the Branch and within 7 days of each meeting shall for-

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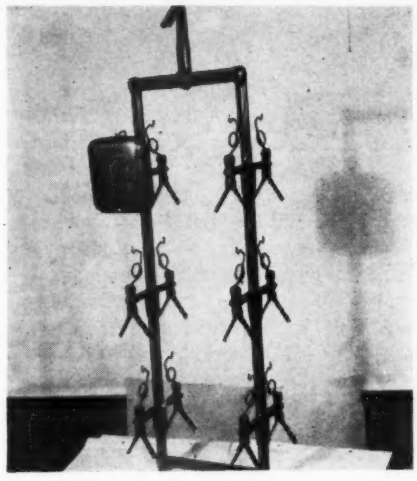
Our central location and modern equipment are your assurance of quick delivery and lower shipping costs.

National Rack Company manufactures all types of plating racks to its own or your design, or will insulate racks made by others. At the present time, we can offer 10 days to two weeks delivery on any quantity of new racks and two days delivery on insulation work.



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All racks we manufacture are equipped with NARACO Removable Work Holders*—PLUS special rack insulation that will not contaminate your electroplating solution, nor disintegrate while in use—guaranteed for one year of normal treatment.

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All-Purpose CLEANERS

ELECTROPLATING AND POLISHING EQUIPMENT
PLATING RACKS
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Chromium
Cadmium
Lead
Tin
Copper
Zinc
Silver

The performance of Harshaw chemicals will confirm your judgment in purchasing them. For more than 50 years the selection of Harshaw chemicals has proved to be the correct choice for thousands of buyers. ● The Harshaw trademark symbolizes unvarying first-line quality. It assures you that the Harshaw laboratories are striving for perfection and continuously searching for new developments . . . and that control laboratories in each Harshaw plant guard carefully the quality of the products manufactured. ● You will make a correct decision . . . exercise good judgment . . . and help yourself to progress . . . when you specify Harshaw chemicals.

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THE HARSHAW CHEMICAL CO.
1945 East 97th Street, Cleveland 6, Ohio
BRANCHES IN PRINCIPAL CITIES

ward to the Executive Secretary a record of the meeting and copies of all appropriate papers offered for publications by the Society". The members of the Constitution Revision Committee have, therefore, seen fit to retain this provision, the value of which may not be fully appreciated by the members and, more particularly, the Branch secretaries.

Many members of the Society are interested in reading the news of other Branches. Frequently the mention of a paper on a timely topic in a report by one Branch leads other branches to engage the same speaker on the same subject. Papers for the monthly publication, PLATING, have also been obtained in this manner. By reporting these activities for publication under the Branch News, the Branch also gives speakers and their sponsoring companies deserved publicity.

A more important reason for accurate reports of each Branch meeting is to maintain a permanent record of the Branch activities which, in effect, serve as a chronological history of the Branch. We are currently endeavoring to obtain historical data on each Branch of the Society. On November 4, 1947 a questionnaire was sent to all Branch secretaries requesting information of this nature. On December 23, 1947 a second request for this information was sent to all Branch secretaries. To date only sixteen Branches have replied.

Some of the replies express regrets that all of the pertinent data is not available. In this connection, George B. Hogaboom, who was appointed to write the history of the Hartford Branch, advises that he has read all the reports in THE MONTHLY REVIEW and is amazed at the number of Branches that have few or no reports in the past. He further states, "In my opinion Branch secretaries do not realize the value of these reports. They are indispensable for a history of a Branch".

In the Annual Report for the year ending April 30, 1947, the Executive Secretary said, "It is interesting to note that only eight branches have had from ten to eighteen news items published in the past year. Sixteen branches have had from five to nine news items published, and the published items for the remaining (15) branches varied from zero to four".

The present effort to obtain historical data has emphasized the importance of correcting this situation. If the burden on the Branch secretary is too great, it is suggested that a correspondent be appointed, as has been done by certain Branches, whose responsibility it would be to prepare promptly complete Branch News reports in compliance with the By-Laws. In this way the activities of the Society can be furthered and the danger of losing Branch records through changes of the Branch officers would be eliminated.

A. KENNETH GRAHAM,
Executive Secretary.

Constitution

(*Continued from page 488*)

choosing not inconsistent with the Constitution and By-Laws of the Society. Any special laws or rules of a Branch shall be filed with the Executive Secretary.

Section 3. Finances: A Branch may receive donations or bequests and may expend or invest the same at its own discretion. A Branch may levy assessments and otherwise raise or collect funds for its own purposes and shall have the entire use and management of such funds.

PART III. REVISION OF CONSTITUTION

ARTICLE I

Section 1. Authority: This Constitution or any part thereof may be repealed, altered, annulled, or otherwise amended by a two-thirds vote of all Delegates, either at an Annual Meeting or by letter ballot, after regular procedure of initiative and notice as provided in Sections 2 and 3 of this Article.

Section 2. Initiative: Due notice shall be given and a vote shall be taken on any revision submitted by four or more Branches and approved by the Executive Board.

Section 3. Notice: On receipt of a revision duly submitted, the Executive Board shall immediately cause such revision to be reviewed by the authority constituted for that purpose, properly worded and classified, and published in the official journal of the Society at the first opportunity and in any case not later than three months from receipt of the said revision. Vote of the Delegates on the revision shall be taken within three months of its publication in the official journal.

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● Niehaus Fume Separators will reduce your overhead two ways . . . overhead expenses and space-consuming overhead ductwork. By water absorption and centrifugal separation, it will effectively control the fumes from your cleaning and plating solutions.

The complete unit is located alongside your tank . . . no expensive blowers or long ducts are required. No air is discharged outside.

For complete specifications and information on how the Niehaus Fume Separator eliminates costly equipment, reduces installation costs, and sells for less. Write for illustrated folder.

See a Niehaus Fume Separator in operation in Booth 11 at the A.E.S. Exposition in Atlantic City, June 28 to July 3. The new Niehaus Dust Control Unit also will be shown for the first time.

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AMFLOW

* The versatile bias buff for fast cut and coloring. Anti-raveling, air-cooled.

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* The superior bias buff with the extra sheering to eliminate ridging. It's "super" on flat surfaces. It's anti-raveling and air-cooled

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* These buffs offer extra stiffness, longer life and fast cut and yet are flexible. Save abrasives, less fraying, less burning. Excellent on flat work and nickel.

FULL DISC

* These buffs are made of full discs of various materials. Any type of sewing is available, or, in a loose buff with one sewing around arbor hole.

"AMERICAN-MADE" BUFFS ARE TERRIFIC BECAUSE THEY'R...

THE WORLD'S LARGEST BUFF FACTOR...

ADV. BY S. S. LOVITT CO.

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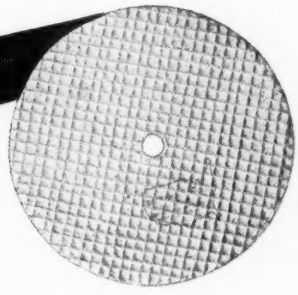
*Pieced Buffs are made of all types of materials and all types of sewings are available. Extremely economical in many cases especially where pieced buffs are as effective as any other type of buff.

SQUARE SEWED



*The square sewings form pockets for holding the abrasives. The stitching saves wear. The finer the stitching the faster the cut. Wider stitching for coloring.

BUFF RECOMMENDATIONS

TYPES OF METALS	BUFFING METHODS: TYPES OF BUFFS FOR CUTTING OPERATION	TYPES OF BUFFS FOR COLORING OPERATION
ALUMINUM		
Stamping	Loose or Pocket	Loose
Casting	Shurflow or Amflow	Loose or Pocket
Forging-Extended	Shurflow or Amflow	Loose or Pocket
BRASS		
Stamping	Spiral Sewed	Pocket or Loose
Casting	Spiral Sewed	Spiral Sewed
Forging	Spiral Sewed	Spiral Sewed
COPPER	Spiral Sewed	Loose
DIE CASTING	Spiral Sewed	Loose
STEEL		
Carbon	Spiral Sewed	Pocket Buff
Cutlery	Shurflow or Amflow	Amflow
Stainless	Shurflow or Folded	Amflow
PEWTER	Loose	Loose
PLASTICS	Loose	Loose

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Branch News

Coming Event

INDIANAPOLIS BRANCH

SPRING MEETING
Saturday, May 22
in Indianapolis Athletic Club
Technical Session 2:00–5:00 P. M.

H. J. McAleer, Formax Manufacturing Company, "Practical Facts About Polishing and Buffing Compounds and Wheels"

Walter Moline, National Cash Register Company, "Electropolishing"

Paul E. Miller, Miller Electroplating, Inc., "An Incentive Plan for Job Shop Plating"

William J. Neill, A.E.S. Third Vice President.

Banquet at 7:00 P. M.
Entertainment— Dancing

Tickets at $5.00 per person should be obtained in advance. Send check with request to Mr. Max Malvase, 275 S. Audubon Road, Indianapolis, Ind.

JAMES J. MONAGLE,
Secretary-Treasurer.

BALTIMORE-WASHINGTON BRANCH

The Baltimore-Washington Branch met March 2 at the American Hammered Piston Ring Company. The business session sisted primarily of a discussion of the desirability of organizing a plating class for the members next year.

A. E. S. PRESIDENT K. M. HUSTON, the speaker for the evening, gave a report on the functions of the Society. He discussed the status of the revision of the constitution and the research program. The future plans for PLATING, the educational program, and the publicity activities were emphasized.

Mr. Huston then presented an interesting paper on the "Finishing of Stainless Steels". Scale removal by blasting, pickling, tumbling, and in molten baths; cleaning with solvents, alkali, acid, pumice, and wire brush; finishing by grinding, polishing, buffing and electropolishing; and color finishing with black and gold were described.

At the close of the meeting, MR. GUERKE made Mr. Huston a member of The Order of the Pot in token of his work as President of the Society. This pot represents a commercial plating problem which was solved during the war. It is essentially a piece of radar test equipment. The aluminum base is first coated with zincate and then plated with 0.0002 inch copper and 0.0003 inch silver, and polished. This is followed by 0.001 inch bright cadmium half way down on the inside. The handle is gold plate over copper on the aluminum.

GRACE RIDDELL, *Secretary.*

BRIDGEPORT BRANCH

FIRST VICE-PRESIDENT C. L. TEMPLE presided at the regular meeting on March 5 at which thirty-six members and guests were present.

RAY GORAL has been appointed Branch Exhibits Chairman to replace FRANK KALAFUS, who remains on the Committee. A. R. MCNEIL and J. G. STERLING were also appointed to this committee.

WILLIAM EHRENCRONA of the Banquet Committee reported that he will handle the entertainment, RAY GORAL the Patronage, EUGENE PHILLIPS the Dinner-Dance, and F. B. GOTTHARDT the ticket sale for the affair on May 8. RICHARD C. BARRETT was appointed member of the Projector Committee.

One man was elected to membership. There were three new membership applications, and two members were suspended for non-payment of dues.

JOSEPH G. STERLING,
Secretary-Treasurer.

BRIDGEPORT BRANCH

MR. L. W. BURTON, Sales Engineer of the Rectifier Division of General Electric Company, Bridgeport, Conn., and a professional engineer, was the speaker at the meeting on March 19. His talk on "Copper Oxide Rectifiers, Their Manufacture and Use in the Electroplating Field" was supplemented by an excellent motion picture. He stressed the importance of so installing the rectifiers that they do not become incapacitated by dirt, dust and fumes and the difficulties encountered on overloading them.

An interesting discussion concluded the meeting, which was attended by forty members and guests.

JOSEPH G. STERLING,
Secretary-Treasurer.

BOSTON BRANCH

DR. DONALD PRICE, Director of Research of Oakite Products, Inc., who has considerable experience in the cleaning field, spoke about "The Chemistry of Wetting Agents" at the meeting on January 8. Dr. Price started with definitions of terms and the technical advances which began in the textile industry. Further developments in industry came faster than the advancement in theory, and more and better wetting agents were brought out empirically. The nature of the atomic structure of wetting agents was shown by molecular models, and chemical formulations were discussed in some detail with particular attention to anionic and cationic agents; several trade types were mentioned as illustrations.

After a lengthy discussion period, the meeting adjourned to the next parlor where beer and pretzels as well as coffee and doughnuts were served by the New England Manager of Oakite Products, Inc., MR. POST of Hartford, Conn., ably assisted by MR. BARBER of Boston.

There was one new application for membership, and eight earlier applicants were elected.

GEORGE P. SWIFT, *Secretary.*

BOSTON BRANCH

MR. MARTVIG J. MOLL, dean of automatic plating with twenty-five years' experience in this field and Chief Engineer of Hanson-Van Winkle-Munning Company, was the speaker on February 5 on the subject of "Automatic Plating Equipment". He showed how automatic equipment by increasing labor efficiency may either reduce labor cost or permit increased output with the same labor cost. Hence it is a device to make money by spending it. As an example were mentioned the original three machines installed at the Gillette Safety Razor Company in 1928 and a new unit now being finished and nearly ready for operation. Various types of machines, both full and semi-automatic, and the need for different spacings of anodes and racks were discussed. Two films in color of installations in several automatic plants were shown.

MR. ARTHUR PEARSON of the Hanson-Van Winkle-Munning Company was elected Branch Exhibits Chairman for the June convention. Several changes in the A. E. S. Constitution were suggested for referral to the A. E. S. Revision Committee. One applicant was elected to membership.

GEORGE P. SWIFT, *Secretary.*

BOSTON BRANCH

The American League baseball film of the 1947 season was shown at the start of the meeting on March 11. All the members present seemed to approve this innovation.

The speaker of the evening, with "Plating Specifications" as his subject, was MR. C. H. SAMPLE of the International Nickel Company, New York City. Specifications are of two types, one to control finishing operations and the other to control performance or use of the finished product. Their primary purpose is to promote cooperation between the plater and manufacturer, and hence they should state clearly, without ambiguity, the results that are desired. Specifications must be on an economically sound basis in order to benefit both producer and consumer.

Color slides were then shown of corrosion tests on zinc, zinc and cadmium, lead, copper and lead, tin, nickel, nickel and copper, nickel and chromium, and copper-nickel-chromium in outdoor weathering, salt spray, and high humidity. The outdoor tests were chiefly in New York City and Kure Beach, N. C.

There was one applicant for membership. GEORGE P. SWIFT, *Secretary.*

99-ZINC

This firmly established bath combines quality with speed and high efficiency. No. 99 zinc solution can be operated at current densities as high as two hundred amperes per square foot, in still tanks and semi or full automatic machines, with deposits of fine grain structure and uniform high brilliance. Promat No. 99 zinc is also unexcelled for barrel plating, offering unusual speed of deposition and fine color.

Promat No. 99 zinc consists of inexpensive make-up salts together with PROMAT C-42 addition agent, which aids in producing the characteristic high efficiency and brilliance of the bath, and PROMAT DOCTOR SOLUTION, which maintains its purity and freedom from heavy metal contamination.

PRO-SEAL

PRO-SEAL is an outstanding product of Promat research. It was the first process to make available a bright, fully protected zinc surface by simple immersion alone.

The value of protected zinc is generally accepted, its resistance to white corrosion even under extreme conditions is proven. Pro-Seal gives maximum protection in a bright finish that greatly enhances the sales appeal of any product and enables zinc plating to compete in many fields with far more costly finishes.

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PROBRITE ZINC

Probrite is a process for the deposition of bright zinc from intermediate or low pH baths. The color and brilliance of the deposit is equal to or better than that produced by the more expensive alkaline-cyanide solutions. The bath is inexpensive, operates at or near 100% efficiency at anode and cathode and has throwing and covering power far in excess of that of the conventional acid zinc electrolyte.

64-CADMIUM

No. 64 Promat deposits the most highly lustrous cadmium of any conventional or proprietary electrolyte. Moreover, as the brilliance of deposit is derived from new cadmium compounds in the bath which are not removed by filtration, the solution is not expensive to maintain.

The bright range extends from three to one hundred and twenty amperes per square foot.

Your present electrolyte can be converted to Promat No. 64 without trouble or great expense, and while we recommend its use with a Promat Kicker, direct current operation is entirely feasible.

THE PROMAT ORGANIZATION has devoted many years to research and development in the field of metal finishing, both protective and decorative. In our Waukegan plant, are extensive laboratories in which new products are developed; and a pilot plating plant in which new products are thoroughly tested on a production scale before they are released.

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BOSTON BRANCH

Mr. Myer Shapiro of Gillette Safety Razor Company, Boston, Mass., discussed gold plating as practiced in his plant at a special meeting held on March 18. The effects of impurities and addition agents were treated in detail; by their control, baths are being operated continuously to produce a satisfactory color at all times. Methods of recovery of gold from dragout and foul solutions was also discussed. Effects of current density, general quality effects, housekeeping, preparation aad maintenance of the cycle were explained.

Mr. Shapiro was followed by Mr. Leonard Chesworth of United-Carr Fastener Company, Cambridge, Mass., who discussed "Developments in Barrel Plating", and covered the nickel and zinc plating cycles employed by his company. Tandem tanks are used. Continuous electrolytic purification of the bright nickel baths is practiced with marked success. The bright zinc plating unit was discussed completely, from cooling arrangement to brightener additions and purification schedules.

A lengthy discussion of the two papers brought the meeting to a close. Two applications for membership were turned over to the Board of Managers. One applicant was elected to membership.

George P. Swift, *Secretary*.

BOSTON BRANCH

Louis V. Gagnon introduced Mr. Ralph McCahan of du Pont Electrochemicals Division as the April 1 speaker. Mr. McCahan had "Trouble Shooting Cyanide Solutions" as his topic. Specific difficulties such as blisters, carbonate, pits, off-color, dullness, contaminants, burns, stray currents and bipolar effects, stains, powdering, white whiskers, hydrogen embrittlement, fuming, failure of steel to take zinc, polarizing anodes, and roughness were listed and discussed in connection with copper, cadmium, zinc, brass, silver and gold plating. Particular attention was paid to the copper baths: the use of partitions of 2-ply, 11-ounce washed canvas sailcloth was explained and recommended to prevent roughness; circulation of the anolyte and catholyte should be maintained through a cake filter to maintain a head in the cathode compartment at all times and thus insure flow of clean electrolyte from the cathode to the anode compartment. The expected life of these diaphragms is 6 to 9 months.

After a brief question period, Mr. McCahan was presented by W. L. Meade with a picture to add to his growing art collection.

Two men were elected to membership and two membership applications were received at this meeting.

George P. Swift, *Secretary*.

BUFFALO BRANCH

At its March 12 meeting the Buffalo Branch decided to hold a special educational session early in the Fall. A committee composed of Roger Sheldon, R. R. Bair, Carl Kilroy and Jim Moneypenny will plan a program that will attract all platers in the area.

Sick Committee Chairman Don Rice announced that Past President Siebert Johnson was in the Millard Fillmore Hospital for a major operation. The members of the Branch responded generously to a call for aid with blood donations.

Plans were discussed for a picnic to be held jointly with the Rochester Branch this summer. Though food and drink promise to be as plentiful as ever, the most anticipated event is the baseball game between the two Branches.

The meeting wound up on a happy note with Dr. Allen Gray of E. I. du Pont de Nemours & Company speaking on electropolishing. Dr. Gray presented a historical summary of electropolishing from its inception to the present time, practical slants on the operation of commercial baths, and the advantages and limitations of each. Samples of electropolished stainless steel illustrated the type of finish that could be expected. The talk was followed by a lively discussion which indicated that platers were more than mildly considering this new production tool.

H. A. Fudeman, *Secretary*.

COLUMBUS BRANCH

The Columbus Branch met on March 19, in joint session with the Central Ohio Section of the American Institute of Chemical Engineers and the Columbus Section of the American Chemical Society, to hear Dr. E. D. Haller of the National Technical Laboratories, South Pasadena, Calif., speak on "Instrumentation".

Dr. Haller described the construction and application of a number of "Beckman" instruments, including the *p*H meters, the quartz spectrophotometer, the infra-red spectrophotometer and the flame photometer.

A. B. Tripler, Jr.,
Second Vice-President.

CHICAGO BRANCH

At the February and March meetings the attendance was approximately one hundred on each occasion. Nine applicants were elected to membership in February, and seventeen applicants in March.

At the February meeting Mr. H. J. MacAleer of the Formax Manufacturing Company delivered a very interesting talk on the manufacture of polishing and buffing supplies. It was especially valuable in that good points of construction and material quality of polishing and buffing wheels were thoroughly discussed.

At the March meeting the Librarian was caught short on a speaker and under compulsion offered a few remarks on cleaners.

On March 23, the Chicago Branch sponsored a panel of speakers for one of the technical sessions arranged by the Chicago Technical Societies Council in connection with the Chicago Production Show. Mr. J. M. Boudreau of Plastic Printing Plates, Incorporated, spoke on "Heavy Electrodeposits on Plastics". Dr. Charles L. Faust of the Battelle Memorial Institute discussed electropolishing, with particular emphasis on electropolishing non-ferrous metals. Mr. J. F. Kreml of the American Rolling Mills took this occasion to announce a method for batch electropolishing stainless steel nuts, screws, and other small articles.

J. H. Monaweck, *Librarian*.

COLUMBUS BRANCH

Some thirty members and guests heard Mr. Merton Lilly, patent attorney at Battelle Memorial Institute, speak on "The Changing Attitude of Courts and the Patent Office Toward Patent Rights", during the April 2 meeting.

Mr. Lilly told of the trend away from very broad claims in patents and pointed out how this will improve the patent system. A rather involved discussion ensued.

A business meeting followed, during which the officers for the coming year were elected. William H. Safranek, Battelle Memorial Institute, was elected president. Assisting him will be First Vice-President Nathan L. Koslin, the Nalin Laboratories; Second Vice-President James Zelein, Buckeye Plating Company; Librarian E. L. Combs, Kight Advertising, Incorporated; and Secretary-Treasurer W. G. Hespenheide, Battelle Memorial Institute. W. J. Neill, Columbus Metal Products, Incorporated; Walter Denney, Belmont Casket Company; and C. J. Slunder, Battelle Memorial Institute, will serve as Delegates, while G. L. Denniston, B. & T. Metals Company; Frank Schladen, Alex Turner Electro Plating Company, and L. A. Maloy, Bron-Shoe Company, will be alternates. The Board of Managers is composed of W. J. Neill, C. L. Faust, and C. J. Slunder.

A. B. Tripler, Jr., *Second Vice-President*.

DAYTON BRANCH

Librarian D. Huff served as chairman of the March meeting, an "Old Timers" Night. We are deeply indebted to C. W. Abbott, Warren Robinson, Robert Vandevander, Fred Bauch, and Roy Crutchfield, who reminisced on activities in the plating shop of twenty or more years ago.

In those days nearly all work was scrubbed with pumice and, if greasy, cleaned with kerosene or gasoline. Specifications were rarely heard of; if the parts had the appropriate metallic color, they were accepted. Usually solutions were controlled by dark and mysterious procedures, one noteworthy method being "dumping" in which the solution went down the drain to be replaced by one freshly made up. Although the impor-

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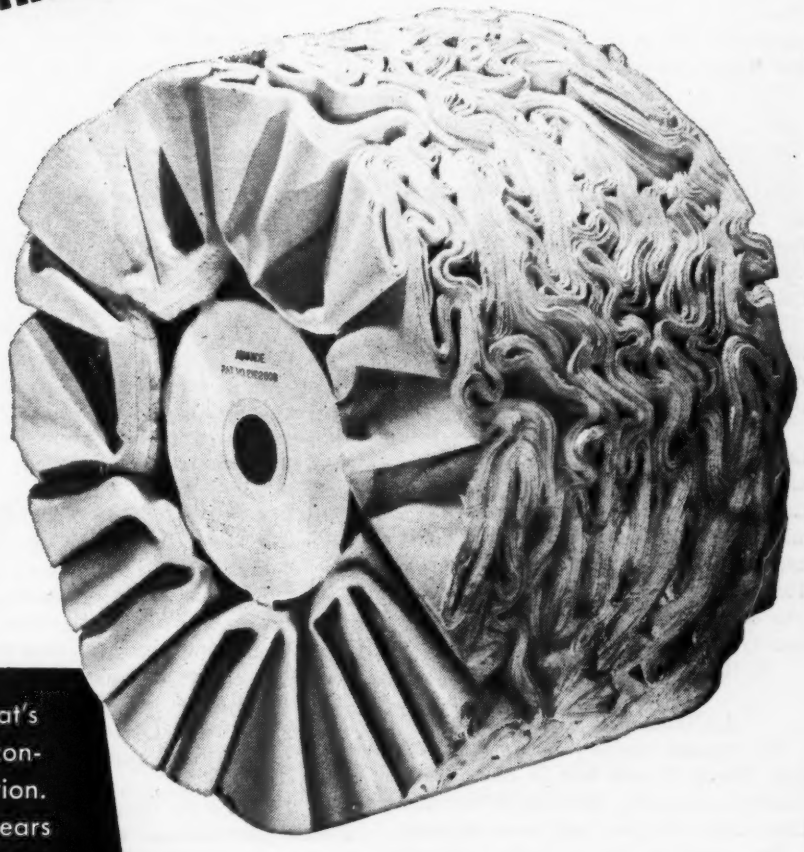

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tance of cleanliness of the work prior to plating was apparently fully recognized by the "old timers", they reversed themselves on occasion when they added a shovelful of buffing department floor sweepings to a newly made-up cleaning solution.

It may be a marvel to the current plating men of shorter experience how many an "old timer" could plate without benefit of ammeter, modern solution purification and control, modern cleaners and cleaning procedures, and other recent advances. The nonexistence of plate thickness requirements, the fact that the metals to be plated in those days were usually iron and brass, plus recognition of the need for clean work explain the success of the "old time" plater; at least, that was the impression left with us by the speakers. Those who were there to enjoy this meeting have a deeper appreciation of the art and science we make our business.

E. W. REHME,
Secretary-Treasurer.

DETROIT BRANCH

At the March meeting in Hotel Statler we first viewed a very fine color film from the Michigan Conservation Department showing the Porcupine Mountain State Park.

The report of the nominating committee was accepted. Officers for the next year will be voted upon by mail ballot before the next meeting.

DR. LOUIS WEISBERG, Consulting Chemist of New York City and Chairman of the Research Directing Sub-Committee of the A. E. S. Research Committee, spoke about the various projects underway and the progress being made. This was especially interesting to those who are concerned with this phase of the Society's activities.

R. H. DUDLEY, *Publicity Chairman.*

LANCASTER BRANCH

The regular monthly meeting on Friday, March 12 was held in the Aircraft Marine Laboratory, Harrisburg, Pa., with thirty-eight members and guests present.

The work of the A. E. S. Research Committee was reviewed by PRESIDENT THEODORE SCHWALM. The following were appointed to the Nominating Committee: WILLIAM KLUNK, Chairman, HARRY BRITCHER, and KARL NUSS. Two applications were approved by the members present and one application was referred to the Board of Managers.

LIBRARIAN CHESTER W. SMITH then introduced MR. ARTHUR S. KOHLER, Chief Chemist of the Frederick Gumm Chemical Company, Inc., Kearny, N. J., who spoke about "Barrel Finishing of Small Parts". Mr. Kohler discussed the effect of size and shape on the burnishing and deburring operations of small metal parts, described the oblique and horizontal barrels, their sizes, and the materials used in their construction. Special attention was given to the type of abrasives used. Mr. Kohler passed among the group many samples showing the work that is being done in this field.

After the meeting had been adjourned, refreshments were served by Charles D. Snyder and Son.

H. CLAY BRUBAKER, *Secretary.*

LOS ANGELES BRANCH

Sixty-eight persons, including ten visitors, attended the regular meeting on March 10.

After nine new members had been "initiated", MR. RICHARD J. WOOLEY of United Chromium, Inc., spoke about "Conversion Coatings". Two methods are commonly used for producing chromate films on zinc and cadmium, namely, chemical immersion treatments and low voltage anodizing. The advantages of each, the drawbacks of the original solutions and how they were overcome, methods of preparing and operating the baths were given, and post-war uses were illustrated with photographs and commercially finished parts.

There were three questions in the Question Box:

Q. 1. What is a good formula for a heavy deposit of copper on wood? A metal thickness of 0.035 inch is desired and an acid solution is preferred. *A.* The solution ordinarily used contains 27 to 30 oz/gal copper sulfate and 6 to 10 oz/gal sulfuric acid. The wood must be thoroughly coated to protect it from the solution and made conductive by any of the usual means.

Q. 2. Approximately how thick can cadmium be applied without appreciable loss of adhesion? *A.* Experienced platers indicated they had seen cadmium applied in thicknesses up to 1/16th of an inch. The general concensus was that the adhesion was more dependent on the surface condition of the metal part being plated, the method of cleaning prior to plating, bath composition, rate of deposition, etc.

Q. 3. Does the throwing power of du Pont copper decrease with increased current density, all other factors being equal? *A.* According to the March issue of PLATING the throwing power of plating solutions does decrease, all other factors being equal.

DEAN WILLIAMS, *Secretary.*

LOUISVILLE BRANCH

The first official meeting of the newly chartered Louisville Branch was held on March 17 at 235 S. Fifth Street, Louisville, Ky., for the purpose of organization under the Constitution and By-Laws of the Society. Fifteen new applicants were accepted into membership and the following were elected to serve as Branch officers:

President—DONALD PATRICK
First Vice-President—P. H. PATE
Second Vice-President—PAUL DE HAVEN
Secretary-Treasurer—STANLEY BEYER
Librarian—THOMAS ALLISON
Board of Managers—WILLIAM BRUSE (Chairman), JAMES HAHN, and HARVEY CURTISS

Other business was discussed but details regarding transfer of memberships, issuance of membership cards, and filing names and addresses with the Executive Secretary were left to the officers.

Mr. Patrick announced the excellent programs scheduled for April 21 and May 19. On May 19, DR. D. GARDNER FOULKE, Hanson-Van Winkle-Munning Company, will present a talk on "Anodizing of Magnesium".

Beginning an organization of this type is not always easy. There are many of us in this area who fervently hope that we can develop an organization which will prosper and earn recognition as one of the better Branches of A. E. S., for only then can we realize fully the benefits that A. E. S. affords.

STANLEY J. BEYER,
Secretary-Treasurer.

MELBOURNE BRANCH

The annual election of officers on January 19 gave the following results:

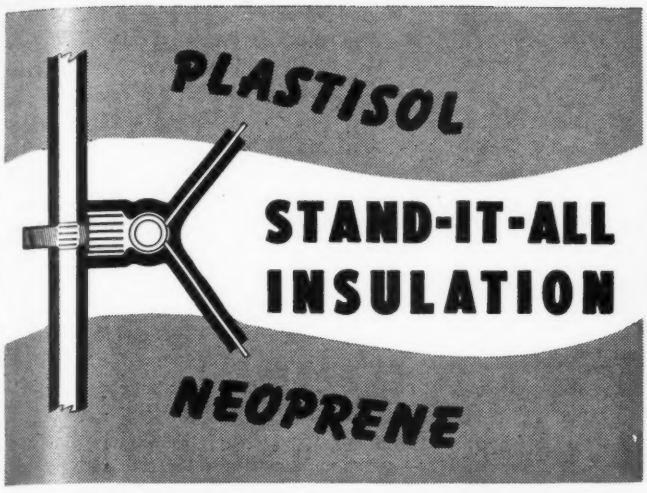
President—GLEN WALKER
First Vice-President—N. L. CARTER
Second Vice-President—M. R. J. ANDREWS
Secretary-Treasurer—L. A. L. FRANCIS
Librarian—K. A. TEAGUE
Board of Managers—K. LEIGH, A. CHESTERFIELD, and J. MCORIST

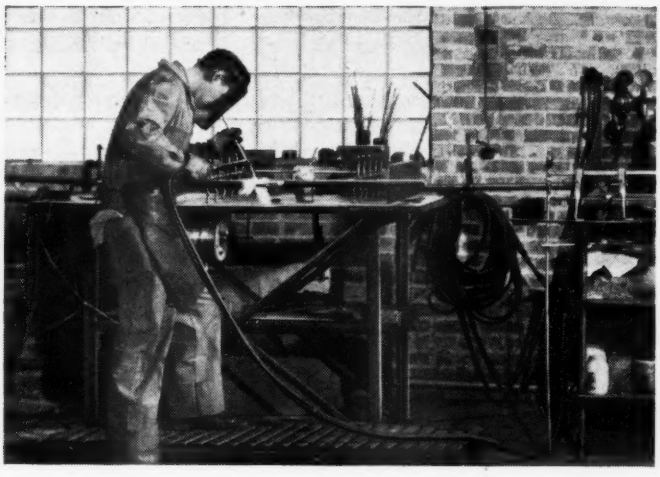
Mr. Francis has since resigned and J. DALE elected to fill his post.

The first educational meeting of the year, our thirtieth regular meeting, was held on February 23 in the Chamber of Manufacturers. It was attended by approximately fifty members and visitors.

The guest speaker was MR. P. F. THOMPSON, world authority on the corrosion of metals, and it was fitting that he should speak to us on this important subject. Mr. Thompson first dealt with the fundamental principles of corrosion and impressed on his audience never to be sidetracked into imagining that corrosion was anything more than the losing of electrons by metal atoms—although nowadays it is common to find many confusing words linked with corrosion. He then developed his discussion to cover various types of corrosion, including particularly those characterized by hydrogen evolution and differential aeration. The effects of heating and the advisability of venting boilers to prevent an unnecessarily high oxygen content remaining in boiling water were also discussed in some detail.

The importance of ensuring that metal surfaces are as even as practical was pointed out, and the tendency to corrosion of iron having uneven or dissimilar coatings of scale was cited as an example of the production difficulties and waste





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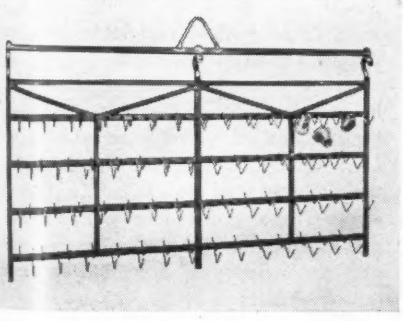

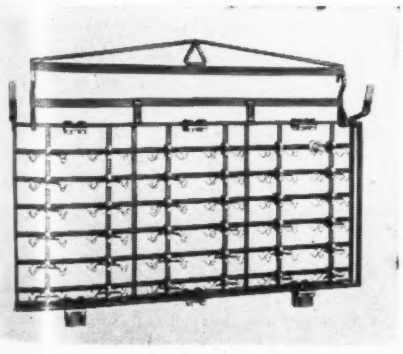

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inherent in material having dissimilar surfaces. In this regard, the danger of corrosion of metals coated with porous electrodeposits was mentioned.

Finally the speaker briefly referred to his pioneering work connected with stainless steels and with specific corrosion problems which were of utmost importance in this theatre during the recent war.

Throughout the lecture, numerous original lantern slides were projected; of great interest was the novel demonstration of corrosion experiments in glass cells which were inserted into the projector in place of ordinary slides. It was thus possible for the whole audience to watch metals being attacked under various conditions, and these practical demonstrations were very popular features of the evening.

Mr. Thompson spoke for over one hour and a half, which is much longer than our normal lecture, but his subject was so important, his presentation so interesting, and his discussion so clear, that genuine regret was felt by all present when his address concluded.

N. L. CARTER,
Plating Correspondent.

MILWAUKEE BRANCH

MR. HARRIS G. BECK, JR., Technical Director of Zapon Division of Atlas Powder Company, was the speaker at the 388th regular meeting on March 5. His talk on "The Testing and Manufacture of Industrial Finishes" proved very interesting.

RAY GOODSELL, a Past President of A. E. S. and very active Milwaukee Branch member, was made an Honorary Member of the Branch.

About fifty members attended the meeting. Refreshments were served.

JAMES DURNFORD, *Secretary.*

MONTREAL BRANCH

The speaker at the regular monthly meeting on March 2 was MR. REG. GORDON, Superintendent of R. C. A. Victor Record Division, who discussed "Plating as Applied in the Manufacture of Gramophone Records". Mr. Gordon explained in detail and in an interesting manner stages of the process from the metallizing of the original acetate blank to the production of the metal stamper and exhibited samples illustrating each stage. Close solution control is necessary to produce the required fine deposit structure.

MR. J. T. REISENBERG of Lea Products Company contributed much to the enjoyment of the evening when he introduced one of the hotel staff as "Minister to the Interior". Due to his ministrations a very jovial atmosphere was induced.

The Educational Committee has been very busy contacting the technical societies in Montreal with a view to obtaining as large an attendance as possible at the special meeting on April 26 at which A. E. S. PRESIDENT K. M. HUSTON will be the guest speaker.

MR. GUS BLOXALL, one of the charter members of the Montreal Branch, was elected an honorary member of the Branch.

A nomination slate of officers for the coming year was proposed and accepted.

WILLIAM GLOVER, *Secretary.*

NEWARK BRANCH

One hundred and forty members and guests came out to hear the three featured speakers at the Spring Educational Meeting on March 5. LIBRARIAN ZACHARY IRENAS introduced the speakers and handled the discussions that followed each presentation.

MR. W. H. JACKSON of the Udylite Corporation delighted his audience with his discussion of good and bad practices in production barrel plating. He assisted his audience by making references to diagrams and tables, copies of which were in the hands of each listener.

DR. G. DUBPERNELL, Manager of the Waterbury Laboratories of United Chromium, Incorporated, spoke very elegantly on the history of the development of chromium plating by the barrel method. His company is now in the process of building a much larger barrel than any now in existence for the plating of larger parts.

MR. K. M. HUSTON, A. E. S. President, discussed activities of the Executive Board in connection with the Research Fund: an effort is being made to increase substantially the number of sustaining members; new projects on physical properties of electrodeposits, plating waste disposal methods, current distribution in plating, cleaning, and internal stresses in electrodeposits have been decided upon; research findings will be available to a number of cooperating technical societies. Among other subjects now before the Executive Board for discussion are means for obtaining material suitable for course work in plating in secondary or technical schools and the production of visual aids, such as films, etc.

PRESIDENT HOWARD COBB took charge of a short business session at which it was decided to present the following amendment to the By-Laws, Part I, Article IV, Section 4(d), to the Supreme Society:

"All moneys collected in connection with a convention by any means whatsoever are to be applied against actual expenses of said convention. Any profit accruing after all expenses have been paid is to be divided 35 per cent to the Branch holding the Convention and 65 per cent to the General Fund of the Society."

All were very happy to hear Mr. Irenas announce that HORACE SMITH is over the "hump" and will be out of the hospital in a few weeks.

S. S. FREY, *Recording Secretary.*

NEWARK BRANCH

Forty-five members and guests attended the meeting on March 19.

MR. WALTER PRINE, a chemical engineer of the International Nickel Company, was introduced by LIBRARIAN Z. IRENAS and spoke about nickel plating, emphasizing its applicability to the manufacture of industrial products and giving bath formulas and normal operating features. He provided his listeners with small nickel plated or nickel electroformed articles for their inspection. Some time was devoted to the major troubles encountered in nickel plating and how they may be corrected. A lively discussion period followed the speaker's presentation. All present received a mimeographed copy of the formulas and operating conditions for the major types of nickel bath now in service in this country.

Four applications were received and two applicants were elected to membership.

S. S. FREY, *Recording Secretary.*

NEW YORK BRANCH

Three new members were elected and four new applications for membership were received at the meeting on February 13.

MR. DAVID CLARIN, Chairman of A. E. S. Publicity Committee, explained some of the "methods" of the A. E. S. Executive Board's so-called "madness". He described the many new problems that have arisen due to the rapid growth of the organization and the efforts which are being made to solve them.

MARTIN MAHER conducted a "Good and Welfare" program which included discussions of nickel and chromium plating of grey iron castings.

MR. A. W. WALLBANK, Vice-President of the Electrodepositors' Technical Society, England, was the guest at the meeting on March 12. He spoke briefly about the work of his society and later gave us a picture of barrel chromium plating as it is practiced and controlled abroad. In his opinion, the chromium solution was best controlled visually since analytical methods are quite lacking for determination of the fluoride radicals used. He stressed the importance of mechanical maintenance of the plating barrel which must be stripped of deposited chromium quite regularly.

A lively discussion followed on barrel chromium and general finishing problems.

Two new applications for membership were received.

ALBERT G. FUSCO,
Recording Secretary.

PHILADELPHIA BRANCH

PRESIDENT ORLIK opened the regular meeting on February 27 with about fifty-five members present.

LIBRARIAN HIRSCH introduced the speaker of the evening, MR. ELMO E. OATHOUT, Products Engineer of the Behr-Manning Corporation, whose subject was "Coated Abrasives and Their Place in the

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Electroplating Shop". Mr. Oathout started his talk with a historical survey, beginning with the dim past when sands and grits of various kinds were used, continuing with the more recent past when set-up wheels and set-up canvas belts were used with emery grains for both outside and inside surfaces, and leading up to the present with synthetic emeries on belts which were said to eliminate, in most cases, the set-up wheel.

The speaker had a small demonstration model and several types of wheels and belts which could be used on most of the machines now used in this vicinity. These were demonstrated at the close of the meeting.

Four applications for Branch membership and one for membership at large were referred to the Board of Managers. Two men were elected to Branch membership and two to membership at large. There were one resignation and three suspensions.

CHARLES K. GOSS was appointed Branch Exhibits Chairman for the 1948 Convention.

PAUL MENTZER, SR., *Secretary.*

PHILADELPHIA BRANCH

The meeting on Good Friday, March 26, was a dinner meeting at the Hotel Broadwood.

The speaker of the evening, MR. KENNETH M. HUSTON, Senior Engineer, Corrosion and Electrolytic Studies, Armco Research Laboratory, Baltimore, Md., and A. E. S. President, was introduced by LIBRARIAN ALBERT HIRSCH. Following a short resume of the activities of the Society, he exhibited a number of samples of stainless steel with different finishes obtained by machining, electropolishing, manual and automatic polishing, and showing the effects of exposure tests on non-passivated and passivated objects. Mr. Huston held the interest of the members for about an hour. The questions were many and covered a wide range.

Three applications for membership, of which one was for membership-at-large, were referred to the Board of Managers. Three other applicants were elected, one of which to membership-at-large, and two suspended members were reinstated. Seven members were suspended for being in arrears with their dues.

WILLIAM MARCOVITCH made a progress report on his study of the new constitution; at his request PRESIDENT ORLIK appointed FRED FULFORTH and SAMUEL HEIMAN to help finish the job.

PAUL MENTZER, SR., *Secretary.*

PROVIDENCE-ATTLEBORO BRANCH

DR. DONALD PRICE, Chief Chemist of Oakite Products, Inc., discussed "Wetting Agents and Their Relation to the Plating Room" at the March 15 meeting. The development of the three general types, anionic, cationic and nonionic, was traced and their recommended applications set forth. The interrelationship of wetting, detergency and emulsifying action in these types was also discussed.

Beer, pretzels, coffee and doughnuts were served after the meeting through the courtesy of Oakite Products, Inc., and its New England representatives, MESSRS. POST and BELCORE. Many thanks are extended them for a refreshing evening.

The Branch By-Laws Committee submitted its first draft, and each member will receive a copy shortly for his recommendations.

The Nominating Committee submitted a slate of officers for 1948–1949 which will be voted on at the April meeting.

EDWARD A. PARKER,
Secretary-Treasurer.

ROCHESTER BRANCH

The regular monthly meeting on March 19 began with a talk on "Phosphate Coatings on Steel, Zinc and Aluminum" by MR. R. C. GIBSON of Parker Rustproof Company, in which he described the preparation and cleaning of these metals as well as the Bonderizing process. Mr. Gibson also showed slides of corrosion tested untreated painted metal and Bonderite coated and painted metal.

Six men were elected to membership. Due to pressure of his Research Committee duties, W. M. TUCKER resigned as Chairman of the Spring Regional Meeting. PRESIDENT R. L. FLINT will take over for Mr. Tucker. The members voted to hold a joint picnic with Buffalo Branch late in the summer. President Flint was empowered to appoint the Delegates to the A. E. S. Convention.

The following officers were elected for the year 1948–1949:

President—ROBERT FLINT
First Vice-President—JOSEPH HULL
Second Vice-President—JEFF YORKEY
Secretary—JAMES WEAVER
Treasurer—FRED WAGNER
Librarian—CHARLES HENDERSHOTT
Board of Managers—S. GARTLAND, F. DAUGHERTY, J. ADAMS and R. BERGHOLD

SAN FRANCISCO BRANCH

MR. B. G. DAW, President of Lasalco, Inc., St. Louis, Mo., presented a very informative talk illustrated by movies at the meeting on March 11. One movie showed the movement of the work in a horizontal hexagon-shaped barrel with one-quarter, half, and three-quarter loads and its relation to both burnishing and plating. Other movies were of Lasalco automatic return-type plating machines particularly adapted to smaller parts. A brief question-and-answer session followed. All agreed that Mr. Daw's talk was one of the most interesting ever presented before the Branch.

Twenty-six members and eight guests attended the meeting.

JACK HITE, *Secretary-Treasurer.*

SOUTHEASTERN BRANCH

The regular monthly meeting was held on March 11 in Robert Fulton Hotel with twenty members and guests present.

The following members were elected Delegates to the Atlantic City Convention: WILLIAM T. WEYMOUTH, M. E. AWTREY, and CLYDE STOVALL. H. R. STOGNER, CYRUS N. SHEARER, and CHARLES WOOLFOLK are the alternates.

The speaker of the evening was MR. JAMES HUGHEY of the Carborundum Company. His talk on the "Use of Abrasives" was enjoyed by all. We hope to have him with us again in the near fufure.

WILLIAM T. WEYMOUTH,
Secretary-Treasurer.

SYDNEY BRANCH

Two new members were elected and two applications were referred to the Board of Managers at the meeting on March 9. PRESIDENT WRIGHT, VICE-PRESIDENT T. WILSON, and G. TREVENA of the Board of Managers were elected Delegates to the Annual Convention. A ways and means committee was appointed to discuss the possibilities of raising funds to send a Delegate to the Convention.

The meeting authorized the Librarian to purchase a large quantity of textbooks on electroplating to enable a good library to be made available to the members.

The Librarian introduced MR. D. G. STEAD of the Austral Bronze Company, Ltd., who gave an interesting talk on the production of non-ferrous metals. The talk was accompanied by a series of slides which gave the members a good insight into the subject matter.

Twenty-eight members and visitors attended. J. R. GODFREY, *Secretary.*

SYRACUSE BRANCH

On Friday afternoon, February 13, members of the Syracuse Branch were guests of General Motors Corporation, Brown Lipe Chapin Division at Syracuse. After a two-hour inspection tour of the plant and the showing of a motion picture, the meeting was adjourned to the Onondaga Hotel. Here dinner was served and followed by a talk on "Stress-Strain in Plated Coatings" by MR. WILLIAM M. PHILLIPS, Head of the Electrochemistry Department, Research Laboratories Division of General Motors Corporation. MR. F. L. CLIFTON, Secretary-Treasurer of the Detroit Branch, accompanied Mr. Phillips.

The meeting proved to be a notable success. Unfortunately, bad weather made out-of-town travel difficult, but the large turnout was amply rewarded by the unusually fine program both afternoon and evening. The talk provoked considerable interest and the discussion period was lively.

We wish to express our gratitude to Mr. Phillips, Mr. Clifton and General Motors Corporation.

M. P. BOLAND, JR., *Secretary.*

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TWIN CITY BRANCH

Two new members were welcomed at the meeting on March 1, attended by thirty-two persons.

GUNNAR DEEDON was named Chairman of the Nominating Committee, with AL JOYNER and WRAY SCHORR as members. The Auditing Committee is composed of MORRIS KANTAR, Chairman, GEORGE REED, and HART HOLMBERG.

The meeting was then turned over to LIBRARIAN CLIFF BOWMAN, who introduced MR. A. H. DU ROSE of Harshaw Chemical Company, Cleveland, Ohio, who spoke on "Chemicals in Plating" and illustrated his lecture with slides.

ROBERT L. BUCKLEY,
Secretary-Treasurer.

WATERBURY BRANCH

The Waterbury Branch was very happy to have had WALTER PINNER as guest speaker at its December 12 meeting. In his usual interesting and colorful manner, he recounted his experiences in England and France during the Third International Conference. He reviewed the highlights of the meeting and gave his impression and observations of events and of the people of these two countries.

At our meeting on January 9, DR. R. M. WICK gave a talk on "Chromium Plating". Research work at Bethlehem Steel Company conducted by Dr. Wick has developed high speed methods for plating heavy deposits of chromium on tools and machine parts subject to wear. Solution composition and high temperature allow the use of current densities up to 4000 asf with deposition rates of 0.0003 to 0.0008 inch per hour.

Something new in Waterbury is the intention to hold a Ladies' Night at the regular meeting on May 14. A special program is being planned of a less technical nature than usual and full details will be announced at the April meeting.

S. L. HENN, *Secretary.*

WATERBURY BRANCH

At the meeting of the Waterbury Branch held on March 12 in Hotel Elton, MARTIN STERNFELS, reviewing some new developments, discussed various new methods for applying tin and tin alloy coatings to copper and steel. The Allis-Chalmers Company supplied the movie, "Metal Magic", which showed the application of induction heating to hardening, brazing and forging of steel.

DR. D. GARDNER FOULKE of Hanson-Van Winkle-Munning Company gave a talk on the "PR Process", bringing the Branch up to date on this interesting method of getting sound, smooth and bright coatings. Since the original work by Westinghouse was reported to us by Mr. Jernstedt at the 8th Regional Meeting, much additional work has been done to perfect the methods for depositing copper, nickel and silver. Smooth, bright, heavy deposits are now possible without addition agents, and further research, particularly with nickel, is expected to develop the usefulness of the process.

PRESIDENT HENRY STROW appointed EARLE COUCH, RALPH COLTER and BERT SAGE to the Nominating Committee which is to select a slate of Delegates for A. E. S. Convention and Officers for the coming year. Delegates will be elected at the April 9 meeting and officers at the meeting on May 20.

The May meeting will be held on Thursday, May 20 instead of Friday, May 14. This is necessary in order to obtain proper accommodations for "Laddies' Night". Dinner will be at 6:30 P. M. in the main dining room of the Hotel Elton. MR. ORLANDO S. PADDOCK, a certified gemologist, will speak on the "Romance of Gems" and a motion picture entitled "America's First Silverplate" will be shown through the courtesy of the International Silver Company.

S. L. HENN, *Secretary.*

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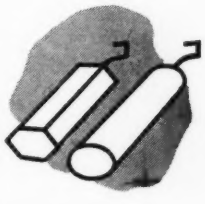

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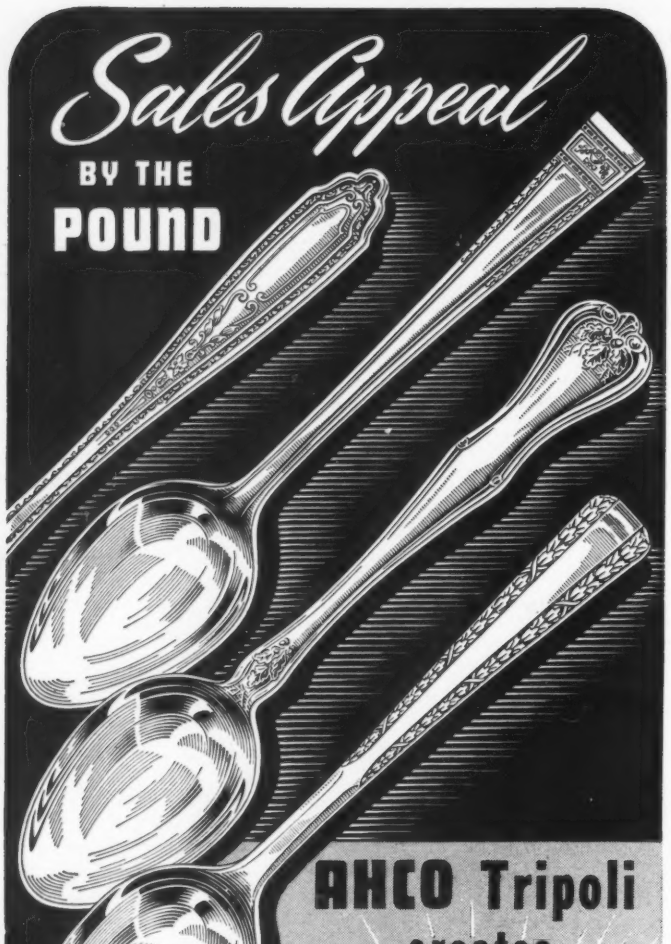

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Stress Data

(*Continued from page 450*)

prietary alkaline copper processes are reported in tests Nos. 19 to 24. These were obtained using the recommended operating condition, except as noted. It should be observed that in spite of relatively high cathode efficiencies, the stress in the deposits vary from a contractile value of 11,100 psi to an expansive value of -5,000 psi.

Of the various changes in the bath composition noted in Tests Nos. 6 to 18 inclusive omitting the rochelle salt, changing the copper concentration, or adding lead or potassium thiocyanate produces significant changes in the stress. There appears to be no consistent relationship between the effects of these composition changes on the cathode efficiency and on the stress in the deposit. On the other hand, changing the operating conditions, temperature and current density, is accompanied by a change in the stress of the deposit which seems to be related to the cathode efficiency.

The significance of stress in copper deposits is not readily visualized. Nickel deposits have long been recognized as being highly stressed, largely, we believe, because heavy deposits tend to curl. Copper, being more ductile, would be less susceptible to such an effect because the stresses can be more easily relieved by plastic flow of the metal. Until data has been obtained relating the performance of copper-nickel-chromium coatings with known stress variations in the deposits, one can only speculate as to the effect of stress on adhesion and cracking tendency.

REFERENCES

[1]Soderberg, K. Gustaf and Graham, A. Kenneth, "Stress in Electrodeposits—Its Significance". Proc. Am. Electroplaters' Soc. 34, 74 (1947).

[2]Phillips, W. M. and Clifton, F. L., "Stress in Electrodeposited Nickel" *ibid.* p. 97.

[3]Hothersall, A. W. "Stress in Electrodeposited Metals". Symposium on Internal Stresses in Metals and Alloys, The Institute of Metals, London (1947); p. 107.

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MEMBERSHIP CHART

BRANCH	Membership May 1, 1947	New Members	Net Change in Membership	Per Cent Net Change
FIRST GROUP				
BOSTON	156	36	+25½	+16.3
PITTSBURGH	126	24	+18½	+14.6
LOS ANGELES	195	44	+18	+ 9.2
CHICAGO	410	78	+35½	+ 8.7
HARTFORD	140	14	+11	+ 7.9
PHILADELPHIA	191	35	+13	+ 6.8
TORONTO	136	17	+ 9	+ 6.6
BRIDGEPORT	147	18	+ 8½	+ 5.8
NEW YORK	257	29	+12	+ 4.7
NEWARK	253	36	+11½	+ 4.5
DETROIT	418	68	+15½	+ 3.7
GRAND RAPIDS	138	36	.....	.....
CLEVELAND	190	23	− 2	− 1.1
SECOND GROUP				
ROCHESTER	87	29	+30½	+35.1
ST. JOSEPH VALLEY	89	18	+ 9½	+10.7
SAN FRANCISCO	76	9	+ 6½	+ 8.6
ST. LOUIS	96	7	+ 6½	+ 6.8
WATERBURY	116	6	+ 3½	+ 3.0
BUFFALO	98	13	+ 2½	+ 2.6
TWIN CITY	89	12	+ 1	+ 1.1
DAYTON	95	10	+ ½	+ 0.5
NEW HAVEN	114	10	− ½	− 0.4
INDIANAPOLIS	103	25	− ½	− 0.5
PROV.-ATTLEBORO	126	24	− 2½	− 1.9
MILWAUKEE	124	15	− 6	− 4.8
BALTIMORE-WASH	117	13	−14	−12.0
THIRD GROUP				
ADELAIDE	49	19	+17	+34.7
TOLEDO	55	27	+19	+34.6
CINCINNATI	55	20	+18	+32.7
LANCASTER	38	11	+ 8	+21.1
SYDNEY	78	21	+12½	+16.0
SOUTHEASTERN	43	12	+ 6½	+15.1
COLUMBUS	35	9	+ 3	+ 8.6
SPRINGFIELD	49	6	+ 3	+ 6.1
SYRACUSE	73	5	+ 3½	+ 4.8
MONTREAL	59	7	+ 2½	+ 4.2
MELBOURNE	61	..	.....	.....
JACKSON-LANSING	65	12	− 1½	− 2.3
ROCKFORD	64	4	− 3½	− 5.5
OTHERS	78	30	+14½	+18.6
TOTAL A. E. S.	4,889	842	+330	+ 6.8

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Resignations

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DETROIT BRANCH: Lynn H. Bradford

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MILWAUKEE BRANCH: Bernard Weber

NEWARK BRANCH: Mathew Payne, Charles J. Perry

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SPRINGFIELD BRANCH: James A. Rabbitt

OTHER: W. H. Hogg

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OTHER: N. F. Blackburn, Edward Turner

Deaths

CHICAGO BRANCH: C. C. Buckingham

CLEVELAND BRANCH: Charles H. Stoddard

MILWAUKEE BRANCH: Louis Zingler

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(*Continued on page 512*)

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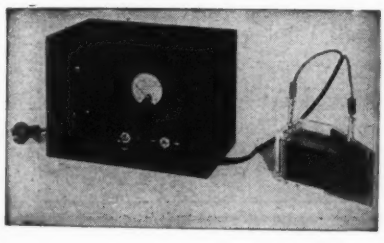

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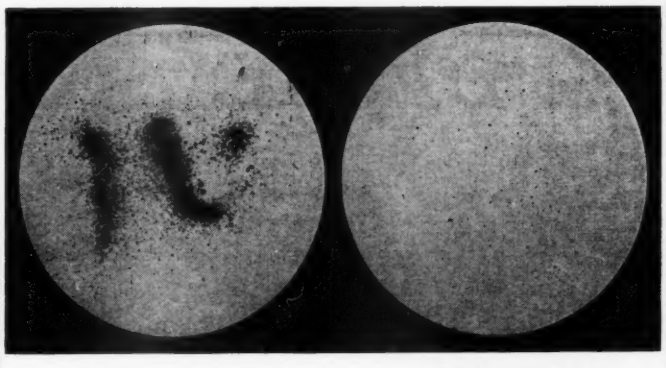

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Charles. Secretary-Treasurer, L. h. Fountain, 15 Cortland Street, Springfield, Mass.

ST. JOSEPH VALLEY meets first Wednesday of each month at 8 P. M. in Hotel Elkhart, Elkhart, Ind. Secretary-Treasurer, Harold J. Wiesner, 1016 Osolo Road, Elkhart, Ind.

ST. LOUIS meets second Wednesday of each month in York Hotel. Secretary-Treasurer, E. R. Hunleth, 4415 Michigan Avenue, St. Louis, Mo.

SOUTHEASTERN meets second Thursday of each month in Robert Fulton Hotel, Atlanta, Ga. Secretary, William Weymouth, 173 Clay Street, S. E., Atlanta, Ga.

SYDNEY, AUSTRALIA. Secretary-Treasurer, John Godfrey, P. O. Box 31, Auburn, N. S. W., Australia.

SYRACUSE meets second Friday of each month in Bowne Hall, Syracuse University. Secretary, M. P. Boland, Jr., 211 Rich Street, Syracuse 4, N. Y.

TOLEDO meets first Thursday of each month at Commodore Perry Hotel, Toledo, Ohio. Secretary, Gaston Bergeman, 703 Pine Street, Fremont, Ohio.

TORONTO meets second Friday of each month in Royal York Hotel. Secretary, Leonard W. Wray, 105 Ronan Avenue, Toronto 12, Ont., Canada.

TWIN CITY meets first Monday of each month, October through June, in Covered Wagon Cafe, Lodge Room, 114 S. 4th Street, Minneapolis. Secretary-Treasurer, Robert L. Buckley, 318 Builders Exchange, Minneapolis 2, Minn.

WATERBURY meets second Friday of each month in Elton Hotel. Secretary-Treasurer, Spencer L. Henn, P. O. Box Dr. B, Cheshire, Conn.

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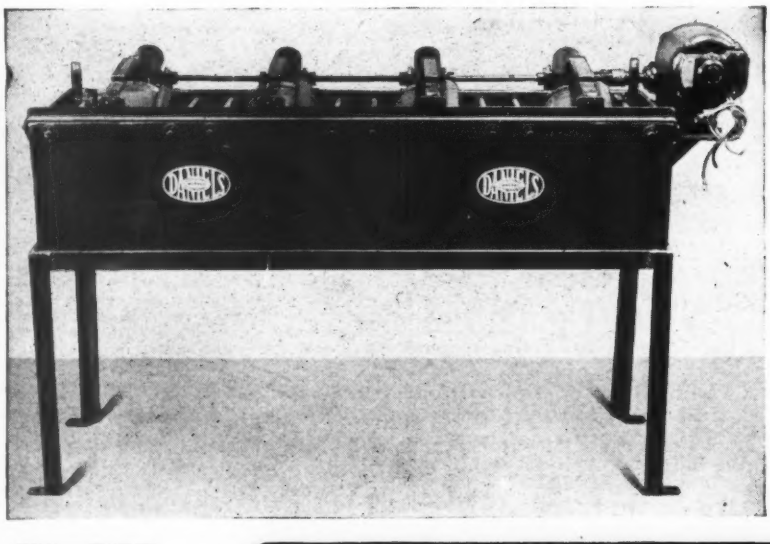

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Future Meetings

BRIDGEPORT BRANCH, A. E. S. Banquet-Dinner-Dance in Stratfield Hotel on May 8.

NIAGARA FALLS REGIONAL MEETING, A. E. S., auspices Toronto Branch, in General Brock Hotel-Niagara Falls, Ontario, on May 15. Educational, session at 2.30 P. M., Banquet at 6:30 P. M.

INDIANAPOLIS BRANCH, A. E. S. Spring Meeting in Indianapolis Athletic Club, on Saturday, May 22. Technical Session at 2:00 P. M., Banquet at 7:00 P. M.

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual Meeting and Eighth Exhibit of Testing Equipment and Related Apparatus in Book-Cadillac Hotel, Detroit, Mich., on June 21 to 25.

AMERICAN ELECTROPLATERS' SOCIETY, 35th Annual Convention and Industrial Finishing Exposition in Ambassador Hotel and Atlantic City Convention Hall, Atlantic City, N. J., on June 28 to July 1.

THE ELECTROCHEMICAL SOCIETY. Fall Conference in Hotel Pennsylvania, New York City, on October 13 to 16.

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